

ONAN MODEL WC4-10S-5

SERVICE MANUAL AND PARTS LIST FOR ONAN ELECTRIC PLANT

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**READ THIS BOOK CAREFULLY AND
PRESERVE FOR FUTURE REFERENCE**

Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC-rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work-harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.

- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [–] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (–) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocutation can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [–] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [–] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

WARNING

THIS ELECTRIC PLANT MUST BE INSTALLED AND BE OPERATED ACCORDING TO OUR INSTRUCTIONS. AN IMPROPER INSTALLATION OR THE USE OF OIL OR FUEL OTHER THAN THAT RECOMMENDED IN THIS MANUAL, RELIEVES THE MANUFACTURER OF ALL RESPONSIBILITY FOR PLANT PERFORMANCE.

READ THIS SERVICE MANUAL CAREFULLY!

GENERAL INFORMATION

THE PURPOSE OF THIS BOOK.— An instruction book is furnished with each ONAN ELECTRIC POWER UNIT. Every owner or operator should read the book thoroughly to familiarize himself with the characteristics of this power unit. A thorough understanding will help greatly to reduce repairs and to allow the operator to determine what the cause of the trouble may be, in the event it occurs.

KEEP THIS BOOK HANDY.— A very simple error on the part of the operator such as the use of improper oil, fuels, or the neglect of routine servicing and inspection may cause the power unit to fail at any time when its satisfactory operation is essential. For this reason, we strongly urge that this book be kept on hand, perhaps near the power unit if possible, so it can be referred to in time of need.

SERVICE.— If trouble occurs or parts are needed which the operator or a capable service man cannot determine, the manufacturer will furnish any advice needed. When asking for advice, be sure to furnish the MODEL, SERIAL and GENERATOR numbers of the plant. This information is absolutely essential. Be sure to furnish all other details available.

IMPORTANT!!!

USE OF LEADED FUELS

The performance of gasoline engines deteriorates with use until it eventually becomes necessary to remove the carbon, grind the valves, install new spark plugs, etc.

Lead is added to many gasolines to increase the octane rating. Due to the action of the lead in the combustion chamber, on the valve seats, and on the spark plugs, the use of such fuels causes the engine performance to deteriorate more rapidly. When using highly leaded fuel, there is a regularly increasing lead content in the crankcase oil.

If the gasoline contains $\frac{1}{2}$ cubic centimeter, or less, of lead per gallon there is little such effect. However, as the proportion of lead is increased the deterioration in engine performance is greatly accelerated.

Under normal operating conditions with unleaded fuel it may be necessary to remove carbon each 1000 operating hours, grind valves each 1000 to 2000 operating hours, clean spark plugs each 200 operating hours, and change crankcase oil each 100 to 200 operating hours.

When using Army 80 octane fuel, aviation 100 octane fuel, or other fuel containing more than 2 cubic centimeters of lead per gallon, change the crankcase oil each 50 operating hours. When using such highly leaded fuels it may be necessary to remove carbon and grind valves each 100 to 200 operating hours, clean spark plugs each 50 operating hours, and replace them each 100 to 200 operating hours. If carbon is removed every 100 to 150 operating hours, the periods between valve grinding jobs usually can be considerably lengthened.

When using leaded fuels, inspect the engine more often and give it the more frequent service required.

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SERVICE DIAGNOSIS

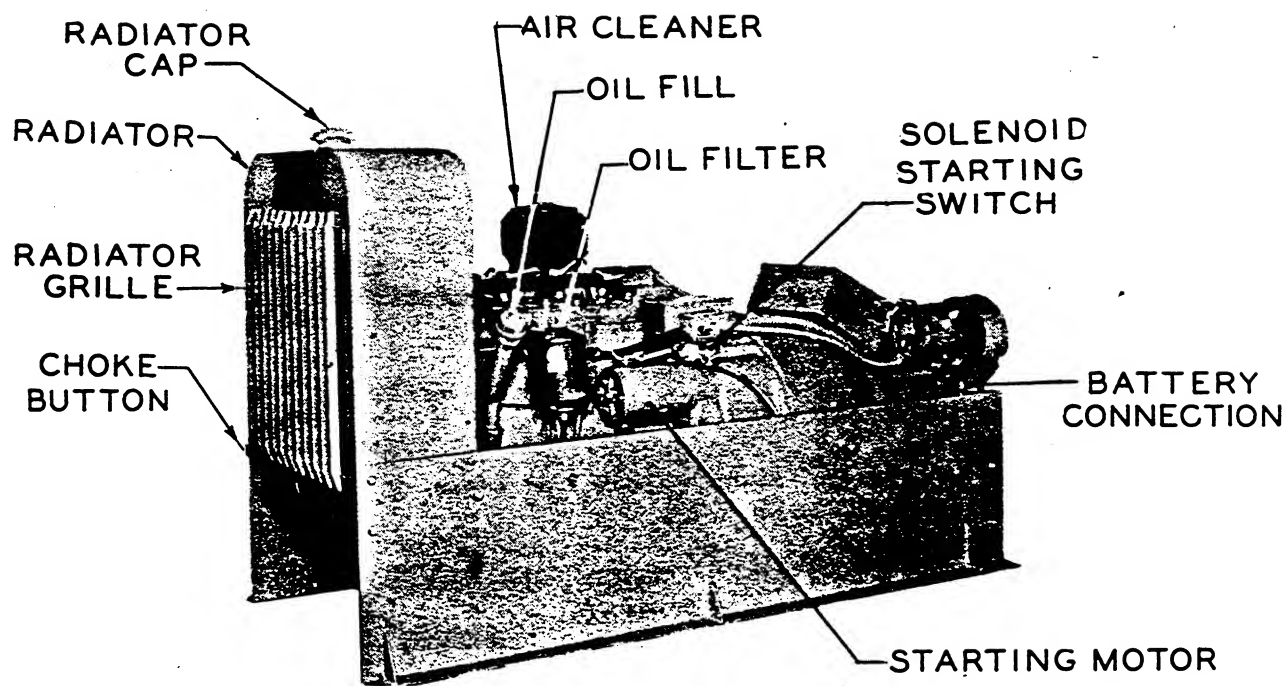
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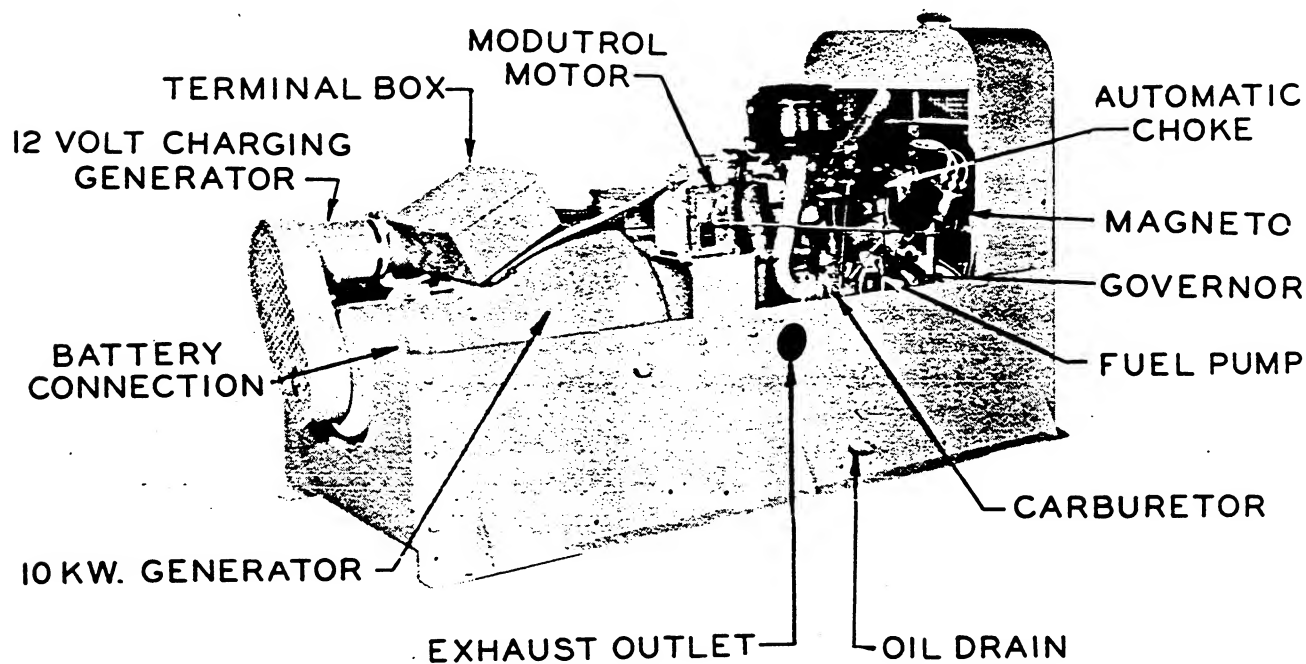
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POWER UNIT WC4-IOS-5 (Right Side)



POWER UNIT WC4-IOS-5 (Left Side)

DESCRIPTION

MECHANICAL DETAILS

ENGINE.— The engine is a vertical, four-cylinder, water-cooled, L-head, four-cycle unit. The cylinder bore is 3.1875 inches; stroke, 3.750 inches; the compression ratio, 6.1 to 1. The engine is directly connected to the generator.

The cylinders and crankcase are one casting. Steel pistons are fitted with three rings. The lower halves of the crankshaft bearings are bolted directly to cross-webs in the crankcase casting. The upper halves of the crankshaft bearings are clamped into the crankcase by the lower halves of the bearings. Connecting rods are fitted with replaceable precision type large end bearings.

A fibre camshaft gear meshes with the cast iron crankshaft gear to drive the camshaft. The magneto drive gearing is contained in a gearcase mounted on the timing gear cover and is driven directly by the camshaft. The camshaft gear also drives the governor gear located at the forward end of the governor shaft. The high-tension magneto used, a Wico JEM-1460B, is impulse coupled to the engine. Spark plugs are 14 mm. Champion H9's. The spark plug cables are carried in a conduit mounted on the cylinder head.

The engine speed is maintained at approximately 1800 r.p.m. to produce 60-cycle output frequency. The speed is controlled by the use of a fly-ball mechanical governor.

An oil type air cleaner is mounted directly above the exhaust-intake manifold. The crankcase is ventilated by air which passes into the crankcase through a filter in the oil filler cap and is then drawn from the crankcase into the carburetor intake.

A six-blade fan is carried on the shaft of the centrifugal type water circulating pump. Both fan and pump are driven by a V-belt. The belt tension is adjustable by means of a ball bearing idler pulley. The fan speed is approximately 1.6 times the crankshaft speed. The water capacity of the cooling system is approximately 13 quarts. The radiator is shielded by a bar type grille mounted on the radiator housing. Cooling air is discharged through the radiator by a pusher type fan. The rear side of the fan is covered by a fan guard.

Oil capacity of the crankcase is four quarts. A gear-type oil pump, driven by the crankshaft timing gear, supplies pressure lubrication to the crankshaft, connecting rod, and camshaft bearings, other internal parts of the engine are lubricated by spray. The oil pressure is regulated by a spring loaded by-pass valve. A Fram Oil Filter, using the replaceable type filter cartridge is mounted on the right side of the engine.

An oil drain is located in the lower left side panel. Oil is drained by removing a 1/2 inch pipe plug.

The carburetor, a modified Marvel-Schebler TSX-126, has adjustable main and idle jets. It is equipped with an automatic choke. The fuel pump is of the conventional automotive, diaphragm type.

DESCRIPTION

The engine may be started from a remote station by a push button which controls the operation of the starting solenoid switch mounted on the generator adapter. An automotive type starting motor with Bendix drive provides electric starting.

The engine may be stopped from a remote station by a push button which may be mounted at any convenient point within the control or the operator's compartment.

A 12-volt battery charging generator, mounted on the exciter generator of the main generating unit is provided for charging starting batteries. The battery charging generator is driven by a V-belt from a pulley on the rotor shaft of the main generator. The belt should not be adjusted too tightly. It is adjusted in a manner similar to the adjusting of the fan belt. The charging rate of the battery charging generator is controlled by a voltage regulator which allows an initial 30 ampere rate to taper off to a finishing rate of approximately 12 amperes.

GENERATOR.— The main generator is of the four pole, revolving field, alternating current type. The frame is bolted to an adapter casting, carried on the engine flywheel housing. The armature is directly coupled to the flywheel of the engine, and is supported at the engine end by the rear main bearing. A flexible metallic disc coupling serves as a solid drive member. The generator blower is bolted directly to the engine flywheel. The outboard end of the armature shaft is carried in a grease sealed ball bearing that requires attention once each six months.

The generator consists of an alternator and its exciter. The alternator includes two main parts, the revolving field and the stator which contains the main a-c windings. The revolving field is excited by direct current supplied through slip rings by the d-c exciting generator. The exciting generator frame is mounted on the rear of the alternator frame and its armature is mounted on the same shaft as the revolving field of the generator.

All windings of the generator are impregnated with insulating varnish and baked.

The rated output of the generator is 10 kilowatts, 115/230-volts, 60-cycle, with a 40 degree Centigrade temperature rise.

Leads from the generator are connected to terminal posts in the terminal box mounted on the generator.

VOLTAGE REGULATION AND FREQUENCY CONTROL.— A Westinghouse Silverstat voltage regulator, included with the power unit, which automatically controls the generator voltages, may be mounted in any convenient location within the operation or the control compartments. The voltage regulator normally holds the voltage within three percent, plus or minus, of the set value. The voltage may be adjusted by means of a rheostat mounted on the regulator.

Manual voltage regulation is also provided through the use of a two-way field circuit switch and a manually operated voltage control rheostat.

DESCRIPTION

By means of the two-way field circuit switch the operator may disconnect the automatic voltage regulator and connect, in its place, the manually operated voltage control rheostat with which the out-put voltages can be raised or lowered at will.

Frequency adjustment while the power unit is in operation may be made by the use of frequency control switches which may be located at any place convenient to the operator within the confines of the control or the operators compartments. This switch controls the operation of the Modutrol motor which, in turn, adjusts the speed and frequency by changing the governor spring tension.

INSTALLATION

The proper installation of your power unit has more bearing on the service it will render than any other factor in its manufacture or use. There are many things to be taken into consideration when selecting the proper place in which to install it. Ventilation, humidity, temperature, and many other factors, are important.

MOBILE INSTALLATION.- Attach the power unit securely to the floor or other supporting member of the vehicle in which it is installed. It should be so installed that it will set approximately level when in normal operation. Take full advantage of the available space in locating the power unit so as to provide proper ventilation and space for servicing. Pipe the exhaust gases outside the vehicle. Keep this pipe at least several inches from inflammable material and support it securely so that it will remain permanently in place. This is important because exhaust gases are deadly poisonous.

Do not run the vehicle into a closed building and operate the power unit without carefully attaching an extension exhaust line that will carry all the exhaust gases outside the building. The size of this extra piping should be increased one pipe size for each 10 feet of length.

VENTILATION.- If the vehicle is a closed one, proper ventilation must be provided. This will require at least two openings, an inlet and an outlet, near opposite ends of the power unit. Several smaller openings will serve, if necessary, but there must be a total of at least 3 square feet of opening for the inlet and a similar amount for the outlet. If necessary, connect a canvas duct to the radiator grille and the outlet opening in such manner that the heated air is forced outside the vehicle and thus prevented from recirculating.

WIRING.- Support all permanent wiring within the vehicle so that vibration will not destroy the insulation or break the wires. Wiring is easily run in any direction. Do not let its location interfere with convenient servicing of the power unit. In the event it is desired to furnish power to an outside load, locate the power unit as near the center of the load as practicable. This assures lower line loss with a given size of wire and improves the voltage regulation at the remote end of the lines. The size of line wires required depends largely upon the distance from the power unit to the load, the amount and kind of load, and the permissible voltage drop between the power unit and the load. The wire used must be large enough for its intended purpose.

ELECTRICAL CONNECTIONS.- Three-wire, 115-230 volt, single phase, 60 cycle service is provided through a-c output terminals 1, 2, and 3, located in the terminal box on the main generator. Service of 115-volts may be obtained by connecting the load between the center terminal (number 2) and either one of the terminals numbered 1 or 3. Either side of the 3-wire system is fully loaded when carrying one-half of the rated full load of the power unit. When the two sides carry equal loads of the same power factor, the system is balanced and the best voltage regulation is obtained. Service of 230-volts is obtained by connecting the load between terminals numbered 1 and 3. Make sure all electric wiring within the room is large enough to carry its load, is properly supported, and is well insulated. All connections must be electrically and mechanically secure.

INSTALLATION

CONNECTING BATTERIES.— Terminal posts for connecting a 12-volt or two 6-volt automotive type storage batteries to the power unit are provided at the rear of the housing. The negative terminal post is grounded to the housing. The battery or batteries should be set as close to the housing as practicable. The negative battery cable should be connected to the negative (-) battery post and to the negative (-) terminal post on the housing. The positive battery cable should be attached to the positive (+) battery post and to the positive (+) terminal post on the housing. Place all cable connectors well down around the battery posts and tighten the bolts securely.

CONNECTING ELECTRICAL CONTROLS AND EQUIPMENT.— Install the A.C. Voltage Regulator, Manual Voltage Control Rheostat model K, Two-Way Field Circuit Switch, Frequency Control Switches, Start-Stop Switches, Charge Ammeter, and Fuel Gauge in compartments where they are easily accessible to the operator and connect them to the power unit as shown in the wiring diagram.

CONNECTING POWER UNIT TO FUEL SUPPLY.— Remove the 1/8" pipe plug in the intake opening of the Fuel Pump, connect fuel supply line from the fuel tank, and tighten. These connections must be very secure.

CONNECTING OIL PRESSURE GAUGE.— Mount the oil pressure gauge at a point within either the engine or the operator's compartment where it can be readily seen by the operator. Connect the gauge tube securely to the gauge. Remove the 1/8" pipe plug from the oil filter tee and connect the other end of the gauge tube to the oil filter tee.

CONNECTING WATER TEMPERATURE GAUGE.— Remove the 3/8" pipe plug from the side of the engine block replacing it with the water temperature gauge which must be screwed securely in place.

PREPARATION

Before starting the power unit for the first time, it is imperative that the following instructions be complied with in the proper sequence.

1. Recheck to make sure all instructions for installation of the power unit have been accorded full and complete compliance.
2. Crank the engine over a few times with the hand crank to make sure that the pistons and the generator move freely. You will find the hand crank attached inside the housing. Keep it there when not in use.
3. Be sure the battery or batteries are well charged. A hydrometer reading of 1.280 indicates a full charge; 1.215 indicates a half charge; and 1.150 indicates a discharged condition.
4. Fill the crankcase with oil to the FULL level as indicated by the bayonet gauge. Use oil of the S.A.E. number according to the lowest temperature to which the power unit will be exposed, as indicated in the following table:

<u>TEMPERATURE</u>	<u>S.A.E. NUMBER</u>
Above 32° F.	S.A.E. No. 30
Between 0° F. and 32° F.	S.A.E. No 10 or 10W
Below 0° F.	S.A.E. No. 10 or 10W diluted with 10% kerosene

If practicable, after about 15 minutes of operation, stop the power unit for a few minutes and then check the oil level. The oil filter used on the power unit holds a small quantity of oil which is supplied from the oil in the crankcase. Add oil, bringing the supply to the full mark and resume operation.

CAUTION: Do not put diluted oil into the power unit until ready to start it, as it may separate if allowed to stand too long before use. Mix well just before pouring into the power unit.

5. Remove the winged nut at the top of the air cleaner and lift the filter element from the oil cup. Fill the oil cup to the level indicated with oil the same as used for the crankcase, but do not dilute it with kerosene. Reassemble.
6. Place a drop of oil in each ball joint of the governor-to-throttle control rod and the governor-to-Modutrol control rod.
7. Close the drain cock at the bottom of the radiator and the drain cock on the side of the cylinder block.
8. Remove the radiator cap and fill the radiator to a level about 1" below the bottom of the filler neck with clean, alkali-free water. Distilled or rain water may be used. The capacity is about 13 quarts. If there is danger of freezing, use a standard anti-freeze in proper proportion. Check for leaks and correct any found. Replace the radiator cap.

PREPARATION

9. Remove the fuel tank cap and fill the fuel tank with clean fresh gasoline. Make sure that the vent in the fuel tank is open. Replace the cap on the fuel tank.

Do not service the power unit with gasoline while it is in operation or while a radio transmitter is operating close to it. Stop the power unit before removing the fuel tank cap. Avoid spilling gasoline. During warm weather do not fill the fuel tank so full that expansion of the gasoline will cause an overflow.

OPERATION

STARTING THE POWER UNIT

CAUTION: Make no attempt to start the power unit until all instructions on the preceding pages have been complied with and you have carefully studied the operating procedure hereinafter described.

STARTING THE POWER UNIT ELECTRICALLY.— Proceed as follows:

1. Check the oil level by means of the bayonet gauge. Make sure that the crankcase is filled with proper oil to the FULL mark on the gauge.
2. Turn the Automatic Voltage Regulator control rheostat to its extreme counterclockwise position so that the voltage will be below normal when the power unit starts.
3. See that the Two-Way Field Circuit Switch is in the Automatic position.
4. Press the START button firmly until the power unit starts, but not more than 10 or 15 seconds. Choking is automatic and the power unit should start at once. If it fails to start, wait 10 seconds and then repeat the procedure.

If the power unit does not start after a few attempts, check the fuel supply and the ignition wires and then repeat the starting procedure. NOTE: Oil was placed in the cylinders before shipping and in some cases it may be necessary to remove and clean the spark plugs by washing them thoroughly in gasoline before the power unit will start the first time.

5. Check the oil pressure gauge immediately after starting the power unit. Pressure will be high until the power unit warms up, however, after reaching normal operating temperature it will be approximately 25 to 30 pounds.
6. Turn the Automatic Voltage Regulator control rheostat, slowly, in a clockwise direction to increase the output voltage to the desired value.
7. Allow the power unit to warm up until it operates smoothly. Then connect the load. The power unit should be near its normal operating temperature before being expected to carry its rated full load.
8. The output frequency will vary somewhat with changes in the amount of load on the power unit. The frequency may be increased by momentarily pressing the INCREASE button of the frequency control switch. The frequency may be decreased by momentarily pressing the DECREASE button.

After the power unit is in operation, and the voltage and the frequency have been adjusted, they are automatically held within close limits. Any small change that may be desired from time to time may

OPERATION

be obtained by means of the frequency control switches and the voltage regulation rheostat on the voltage regulator as hereinbefore described.

During operation, the operator should observe the various meters and the oil pressure gauge at frequent intervals and promptly take any corrective measure indicated as needed.

STOPPING THE POWER UNIT

It is good practice to disconnect all load before stopping the power unit. Press the STOP button until the power unit has completely stopped.

STARTING THE POWER UNIT MANUALLY

If the starting battery does not furnish sufficient cranking power, the power unit may be started by hand cranking.

MANUAL OPERATION OF CHOKE.— Pull out the choke button, which is on the lower front radiator housing, as required by temperature conditions and proceed with the cranking of the power unit.

After the power unit has started, continue to provide a rich mixture until it has warmed up. During the first few minutes, push the choke button inward gradually until the full open position is reached without the power unit's hunting because of too rich a mixture or sputtering from a mixture that is too lean.

CRANKING.— Insert the hand crank through the hole below the radiator, engaging it with the crankshaft ratchet. Do not spin or push down on the crank. Use a strong, quick upward pull. Repeat as necessary.

MANUAL VOLTAGE CONTROL

If the Automatic Voltage Regulator fails, the operator may regulate the voltage manually by proceeding as follows:

1. See that the two-way field circuit switch is in the manual position. DO NOT CHANGE THE POSITION OF THIS SWITCH AT ANY TIME WHILE THE POWER UNIT IS IN OPERATION.
2. Slowly turn the manual voltage control rheostat model K until the desired voltage is obtained.

ABNORMAL OPERATING CONDITIONS

COLD TEMPERATURES

Temperatures below 0° F. require that special attention be given to lubrication, cooling and fuel.

LUBRICATION.— For temperature below 0° F. use S.A.E. 10 or S.A.E. 10W oil diluted with 10% kerosene for crankcase lubrication, as an aid to starting and to assure proper lubrication. If the crankcase is filled with undiluted oil, run the engine until warm, then drain the oil and replace the drain plug securely.

Thoroughly mix 1 pint of kerosene with 4 quarts of S.A.E. 10 or S.A.E. 10W oil. If kerosene is not available use 1 pint of a good grade of distillate instead. Do not dilute heavier than S.A.E. 10 oil.

Fill the crankcase with the diluted oil to the FULL mark on the bayonet gauge and immediately run the engine 10 minutes to circulate the mixture throughout the lubricating system.

Never add kerosene alone to the crankcase. Mix with the oil before pouring into the crankcase. This applies to oil added between changes, also.

When using diluted oil, change the oil every 64 operating-hours and check the level every 8 operating hours, or oftener if experience shows it to be necessary.

AIR CLEANER.— For temperatures below 32° F., use S.A.E. 10 oil. If congealed S.A.E. 10 oil or frost formation within the air cleaner restricts the flow of air, remove and clean the air cleaner. Re-assemble and use without oil. As soon as temperature and humidity conditions permit, oil should be used with the cleaner in the normal manner.

COOLING SYSTEM.— The liquid in the cooling system must be protected if there is any possibility of its freezing. Use any good anti-freeze as directed by the manufacturer. Common ones are alcohol, Prestone and Zerone. Never use kerosene or distillate. Drain the cooling system while it is warm, not hot, and flush it with running water or an approved flushing agent. Never flush a very cold cooling system with water or any solution which may freeze upon contact with the cold metal and cause damage.

Close both drain cocks and fill the cooling system to within one inch below the bottom of the radiator neck with a solution of water and anti-freeze mixed in proper proportions.

Check the cooling mixture often, both as to amount and degree of protection. Protect to a temperature at least 10° below the lowest temperature that may occur.

In extremely cold weather, it is possible to control the temperature of the compartment in which the power unit operates by simply closing a portion of the discharge opening. In this way, a normal temperature

ABNORMAL OPERATING CONDITIONS

can be maintained in a room even though the temperature outdoors might be as low as -30° F. Avoid overheating.

FUEL.- Give special attention to fuel. Fresh fuel and higher test fuel aid starting. Keep the fuel tank nearly full, reducing condensation. Never fill entirely full with cold gasoline.

HOT TEMPERATURES

Under extremely warm operating conditions be sure there is ample ventilation. Keep the radiator well filled and the fan belt properly adjusted. Keep the crankcase oil level near the FULL mark. Flush the cooling system, if necessary, and refill. Be sure the radiator hoses are free of obstructions.

DUST AND DIRT

Under dusty, dirty conditions keep the power unit as clean as practicable. Check operation more frequently and service the power unit as needed.

1. Clean the air cleaner and refill the oil cup as often as necessary. Check it daily.
2. Change the oil filter cartridge as often as the oil begins to darken.
3. Clean the generator commutator, slip rings, and brushes often.
4. Make sure that the brushes ride freely in their holders.
5. Keep all supplies of fuel and oil in air-tight containers.

PERIODIC SERVICING

Follow a definite schedule of inspection and service to maintain a high level of operating efficiency. More detailed instructions for adjustments follows in the Accessory Service section. Lubrication is an important part of periodic servicing.

The service periods indicated are for normal service. For extreme conditions of load, temperature, frequent starts, dust and dirt, service oftener.

If the power unit operates less than 8 hours daily, give the 8-hour service daily. If operation is less than 64 hours weekly, give the 32 and 64-hour services weekly. If operation is less than 256 hours monthly give the 128 and 256-hour services monthly. If operation is less than 1024 hours each 3 months, give the 512 and 1024-hour services each 3 months.

Check the various gauges and instruments frequently and promptly take any corrective measures indicated. Service only while engine is not running. Observe safety precautions.

SERVICE EVERY 8 OPERATING-HOURS

RADIATOR.-- Check the cooling liquid level and add liquid as needed.

CRANKCASE OIL LEVEL.-- Check the oil level as shown by the gauge and add oil, if needed. Never operate the power unit with the oil level below the SAFE OPERATING RANGE indicated on the bayonet gauge.

AIR CLEANER.-- Check oil level and refill to proper level.

FUEL SUPPLY.-- Check the fuel supply. Add proper gasoline as necessary to assure ample fuel in the tank at all times. At full load the power unit uses approximately three gallons of gasoline each hour.

SERVICE EVERY 64 OPERATING-HOURS

BATTERY.-- Test and add distilled water, if needed.

FAN BELT.-- Inspect the fan belt. Adjust or replace, as needed.

CRANKCASE.-- Drain and refill to proper level.

AIR CLEANER.-- Disassemble, clean and refill.

LUBRICATION.-- Lubricate the following with lubricating oil: carburetor throttle shaft bearing, governor ball joint, throttle, governor and Modutrol link bearings.

SERVICE EVERY 256 OPERATING-HOURS

SPARK PLUGS.-- Clean and adjust the spark plugs.

BATTERY CONNECTIONS.-- Clean and tighten the battery connections, if needed. Keep coated with petroleum jelly or grease to retard corrosion. Install new cables, if needed.

PERIODIC SERVICING

MAGNETO.-- Clean the magneto distributor inside and outside. Adjust breaker contacts to .015" gap when wide open. Install new contacts, if needed. Inspect cables and replace, if needed.

FUEL SEDIMENT BULB.-- Clean the fuel sediment bulb and screen.

ENGINE COMPRESSION.-- Check the compression of the engine cylinders by means of the hand crank. If compression is poor on one or more cylinders and the trouble cannot be corrected in the field, return the power unit to the depot for repairs.

CARBURETOR.-- Drain the carburetor and replace the drain plug.

GENERATOR.-- Examine the commutator, slip rings, and brushes. Clean, adjust or replace as needed.

EXHAUST SYSTEM.-- Inspect all exhaust connections. Tighten or replace all parts requiring it.

GENERAL.-- Inspect the power unit thoroughly for leaks, loose electrical connections and other external items that may need attention. Make needed corrections.

SERVICE EVERY 512 OPERATING-HOURS

MAGNETO.-- Lubricate with S.A.E. 10 oil.

SERVICE EVERY 1024 OPERATING-HOURS

FAN IDLER BEARING.-- Lubricate, using a approved general purpose grease .

GENERATOR END BEARING.-- Lubricate, using an approved general purpose grease.

INSPECTIONS AND ADJUSTMENTS

GENERAL

The operator should become familiar with the performance and the sound of the power unit under various operating conditions so that he will recognize any unusual condition that requires attention. He should notice the performance whenever near the power unit. Loose bolts or screws should be tightened at once. Leaks should be corrected promptly.

The Periodic Servicing Schedule should be followed closely. This section includes instructions for adjustments which the operator should be able to make when needed.

If trouble develops, the operator should follow an orderly procedure in determining the cause before attempting repairs.

AIR CLEANER

Loosen the long thumb-screw at the bottom of the air cleaner and lift the cleaner from the power unit for cleaning. After removing the thumb-nut from the top of the cleaner, the cover and element may be lifted from the cup. Clean the old oil and sediment from the cup. Clean the element thoroughly by sloshing up and down in a suitable cleaning fluid or in gasoline. Allow it to dry or dry it by using an air hose. Fill the cup to the level mark with clean oil of the same kind as used in the engine crankcase, but never diluted with kerosene. Reassemble and install the cleaner, tightening the clamp screw securely.

BATTERY AND CABLES

Test the battery with a battery hydrometer weekly. Follow the battery manufacturer's instructions in caring for and installing the battery.

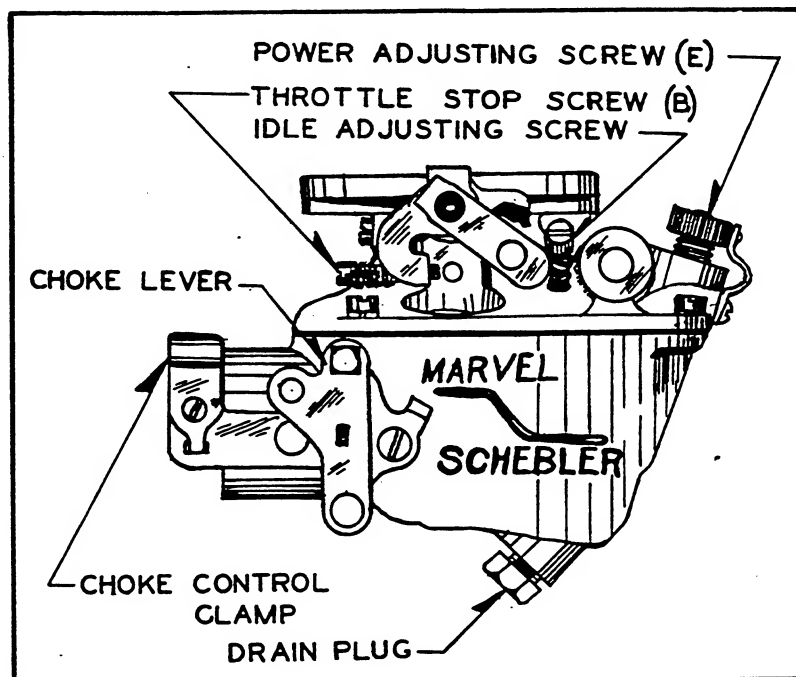
Clean and tighten the battery connections when needed. Apply a coating of petroleum jelly or grease to retard corrosion. Install new cables, if needed.

CARBURETOR

If the engine is not performing correctly, do not hastily conclude that the carburetor is at fault. The ignition system, valve action, compression and fuel system other than the carburetor must be functioning properly before the carburetor can be properly adjusted.

The carburetor may be adjusted in the following manner:

1. Turn the idle adjusting screw entirely in (clockwise) then back it out $3/4$ turn. Due to the fact that the power unit is not required to idle at low speed, this adjustment is not critical and it is better to have it slightly too rich rather than too lean.
2. Start the power unit. After normal operating temperature is reached, adjust the throttle stop screw (B) so that it clears the stop about $1/3$ turn when the power unit is running without load.
3. With the power unit operating at about full load and at normal operating temperature, turn the power adjusting screw (E) in.



CARBURETOR ADJUSTMENTS

(clockwise) slowly until the frequency drops noticeably. Then turn this screw out, one notch at a time, until the frequency rises to normal and the power unit runs smoothly. Note the position of the screw and then turn it out $1/4$ turn further to take care of cold starting conditions.

4. When installing a new carburetor, an approximate adjustment of screw (E) may be made by turning it out $1-1/4$ turns from a closed position. Don't turn the adjusting screws tightly into their seats or damage may result. Complete the adjustment of screw (E) after normal operating temperature is reached.

COMPRESSION

The power unit must have uniformly good compression on all cylinders in order to function properly. Loss of compression may be due to leaking spark plugs, spark plug gaskets or cylinder head gasket. These can be tightened or replaced by the operator. The most common cause of compression loss is leaking valves. Compression loss may result from sticking or broken piston rings or badly worn cylinders. Servicing of valves, pistons and cylinders is a shop job not to be attempted by the operator inexperienced in such work. He can, however, determine when such major service is needed. Loss of compression sufficient to affect the operation of the power unit should be corrected as soon as possible.

When testing the compression, first connect a jumper wire from the magneto ground stud to the power unit so the power unit will not start. Insert the hand crank and pull upward. Compression should rock the crank backward forcibly if allowed to so do when well up on the compression stroke.

Compressed gases leaking past an exhaust valve can be heard at the exhaust outlet. If leaking past an intake valve, a hissing noise may be heard through the carburetor. Remove the air cleaner and disconnect the

exhaust line at the manifold and have someone crank the engine manually while you listen for these sounds, if you suspect that the valves are leaking. If any valve is leaking, all valves should be serviced. A compression leak past the piston rings will cause a hiss inside the crankcase and may be heard at the oil filler opening. Reassemble after testing all cylinders.

EXHAUST SYSTEM

Exhaust gases must be piped outdoors. All parts of the exhaust system from power unit cylinders to outdoors must be kept mechanically secure and gas tight. Examine them carefully. Do not allow the exhaust line to become clogged with carbon. A clogged exhaust line will cause carbon to collect in the power unit and require removal and probably grinding of valves.

FAN BELT

Inspect the fan belt. Do not use a fan belt until it breaks. If the belt surface is broken, install a new belt. If the belt should break in service, the engine might overheat and be damaged to the point requiring major repairs. Too tight a belt will have a short life and cause unnecessary wear on the water pump bearing. A loose belt will slip, become hot and fail to drive the fan and water pump fast enough for proper cooling. Adjust the idler pulley so that the belt tension will permit the belt to be pressed inward $\frac{3}{8}$ " when a pressure of about 8 pounds is applied on the left side of the belt midway between the pulleys.

To adjust the fan belt tension, loosen the idler arm mounting bolt, loosen the adjusting screw lock nut, and turn the adjusting screw to the right or to the left, to increase or decrease tension, as necessary. Tighten the adjusting screw lock nut and then the idler arm mounting bolt.

The fan belt idler pulley and arm assembly must be removed when the pulley bearing is to be lubricated. Loosen the nut of the pivot screw. Loosen the adjusting screw locknut and back the adjusting screw out until the fan belt is free of tension. Disconnect the idler pulley arm at the pivot end and remove the pulley and arm assembly. Wipe all dirt from the assembly. Remove the bearing retaining snap ring and the $\frac{1}{8}$ " pipe plug. Press the bearing and shaft assembly from the pulley by means of an arbor inserted through the threaded hole. Clean the pulley thoroughly in gasoline or suitable solvent and replace the pipe plug tightly. Wipe all grease from the bearing as thoroughly as possible with the finger. Work an approved ball bearing lubricant well into the bearing and wipe away the surplus as before. Then pack the lower half of the bearing compactly with an approved ball bearing lubricant, tapering it from the outer edge of the bearing to the forward end of the shaft head. Press the bearing and shaft assembly into the cleaned pulley, replace the snap ring and install the assembly on the engine. Adjust the fan belt and tighten all nuts securely.

GENERATOR

Remove the cover from the exciter every 256 operating hours, at least.

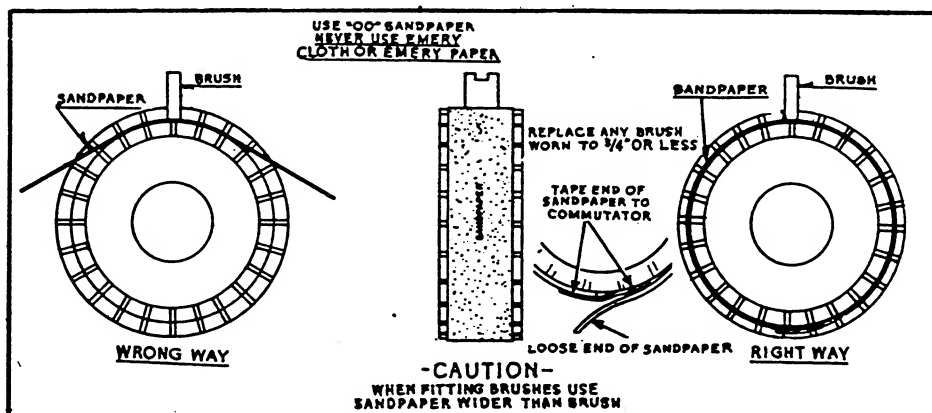
INSPECTIONS AND ADJUSTMENTS

once a month, and inspect the commutator, collector rings and brushes. Make sure that the brushes move freely in holders and have uniformly good spring tension. Replace any brushes worn to less than $3/4$ " in length.

Sand new brushes to a good seating contact. Provide several strips of No. 00 sandpaper as wide as the commutator and long enough to encircle it completely. For use on the slip rings the sandpaper need not be so wide. Some Scotch tape will be required.

Lift all brushes from their holders and place the ends of the brush springs against the sides of the brushes in such position as to hold them high.

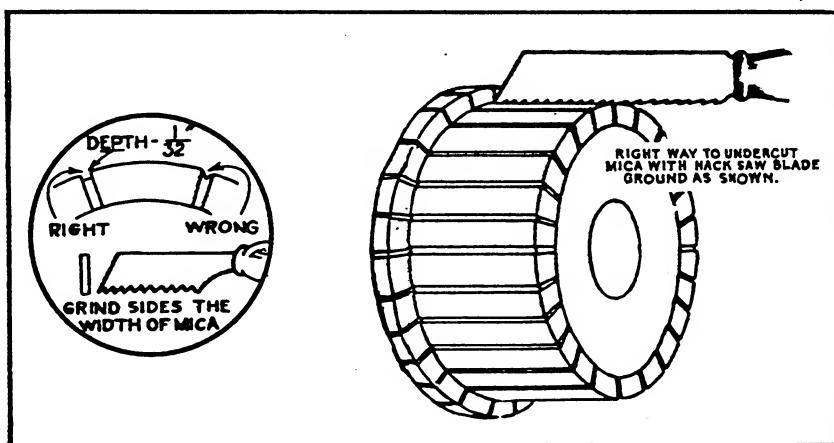
Lay a strip of the sandpaper on a bench, sanded side up. Take a piece of scotch tape about the same width as the paper and 3-1/2" long, and stick it on one end of the sandpaper. It should be in line with, and extend 2" beyond the end of the sandpaper. Now take this sandpaper with tape attached and feed it onto the commutator, or collector ring, as the case may be, in the direction in which the armature normally rotates. This should be done in such manner that the tape may be pressed against, and will adhere to the commutator or collector ring. Crank the power unit slowly and feed the paper carefully so that it will be pulled entirely around the commutator or collector ring, sanded side out.



SANDING BRUSHES

Release the brushes so they rest on the sandpaper with normal spring tension. Crank the power unit until the brushes are sanded to proper seats. Examine each brush every few revolutions and sand no more than necessary to produce proper seats. If necessary, renew the sandpaper. When sanding is completed, remove the sandpaper, tape and all traces of adhesive. Blow the dust away and install the brushes. Observe the brushes under operation to be sure there is no arcing due to improper seating. Then replace the cover.

The commutator acquires a mahogany-colored surface after being in service a short time. If smooth, this surface requires no attention. Slight roughness may be improved by holding a piece of No. 00 sandpaper against the surface while the power unit operates slowly. Brushes should be lifted in holders while doing this operation. A badly worn, burned or pitted commutator will require refinishing in a lathe. After refinishing the commutator, or whenever the copper has worn down flush with the mica insulation which is between the bars, the mica must be undercut $1/32"$.



UNDERCUTTING COMMUTATOR MICA

The edge of the exciter brush ring has a small indentation that coincides with the edge of the upper left supporting boss when the ring is in proper neutral position. This spot is marked with yellow paint on both ring and the support boss. This setting of the brush ring in neutral position should be maintained.

The slip rings require the same attention as the commutator except that there is no mica to be undercut.

After servicing the commutator, slip rings and brushes, blow the sand, copper and carbon dust from the generator.

Lubricate the generator ball bearing according to schedule. Remove the bearing cover, clean out the old grease and fill the bearing housing $1/3$ full of an approved ball bearing lubricant. Pack the grease well into the lower half of the bearing. Be sure the retaining clip which holds the outer race of the ball bearing from turning, in the end bell, is in place. Replace the cover, using a new gasket, if needed.

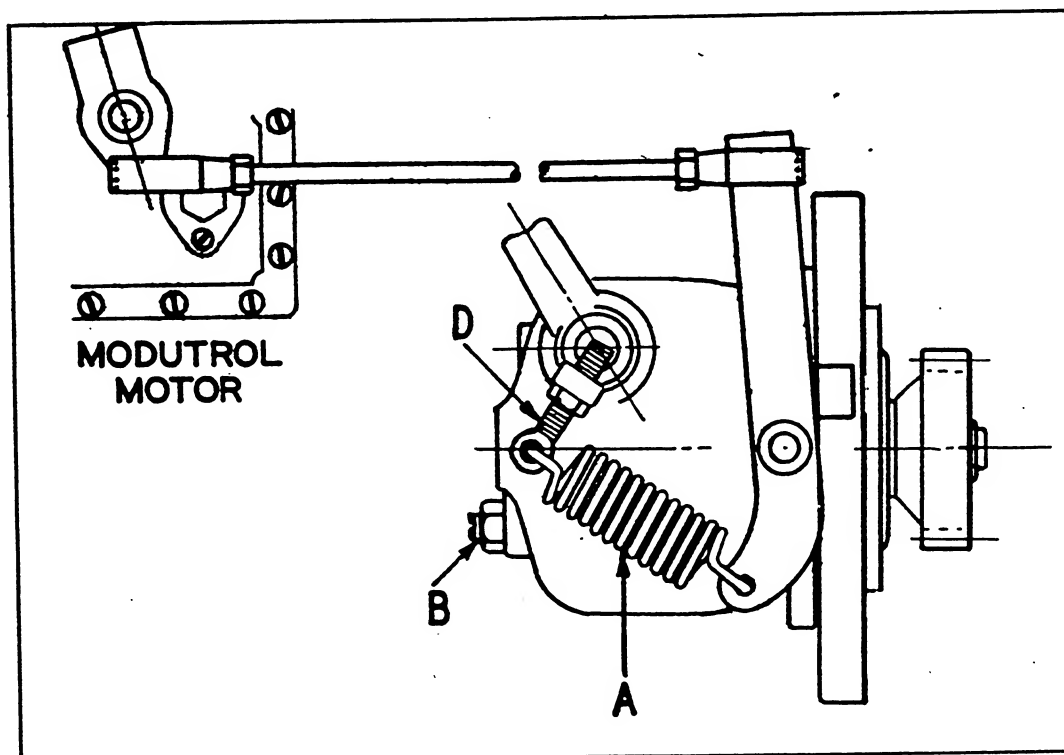
GOVERNOR AND MODUTROL

The governor is lubricated from the engine gearcase and normally requires little attention.

CAUTION: Care should be exercised to avoid disturbing or changing the adjustment of the governor-to-Modutrol motor connecting link.

If it should become necessary to adjust the governor or the Modutrol connection thereto, proceed as follows:

1. With the spring tension on the main governor spring (A), adjust the governor-to-carburetor control link length so that the carburetor lever clears the wide open stop by at least 1/64 inch.
2. Screw the bumper screw(B) out far enough so that it does not function.



GOVERNOR AND MODUTROL

3. Start engine. Press the decrease frequency control switch so that the engine will operate at reduced speed. Allow the engine to reach its normal operating temperature.
4. With the engine operating, at normal temperature, open the cover of the terminal box and place a lead jumper on terminals 5 and 6, causing the Modutrol motor to travel to its full limit in the frequency increasing direction.
5. See that the ball end of the Modutrol arm is pointing to the rear of the power unit and is slightly below center.
6. If it is not in that position, remove the screw and washer from the Modutrol shaft and set the arm in that position.

The ball and socket joints at the end of the Governor-to-Modutrol connecting link must not be so tight as to bind.

7. Adjust the governor-to-Modutrol connecting link to a length that will provide an output frequency of 65 cycles.

8. Remove the jumper from terminals 5 and 6, in the terminal box, and place it on terminals 4 and 5. This will cause the Modutrol arm to turn forward to the full limit of its travel in the frequency decreasing direction. With the arm in this position the frequency should be about 55 cycles.
9. Should the governor surge under load or part load, screw the auxiliary adjusting screw (D) out a few turns at a time until the surging stops. For close regulation, keep the auxiliary adjusting screw in as close as possible, without treating a surging condition. A change in this adjustment may require a change in the length of the governor-to-Modutrol connecting link.
10. If the governor surges while the engine is running without a load, screw in the bumper screw (B) until the surge is eliminated. Tighten lock nut. Don't turn the screw (B) in far enough to increase the engine speed.

LUBRICATION

CRANKCASE.— Check the oil level with the bayonet gauge at least every 8 hours, oftener if necessary. Never run the power unit if the oil level is below the SAFE OPERATING ZONE. Keep level near the FULL mark.

The oil screen, attached to the large plug in the bottom of the oil pan, may be removed for cleaning. This should be done if, at a periodic oil draining, the warm oil does not flow freely from the oil drain. Sluggish flow indicates a clogged condition, probably of the screen. To permit removing the screen, set the power unit over a service pit or hoist it a few inches above the floor and securely block it. Drain the oil with engine warm. Then disassemble the oil drain fittings from the large plug in the bottom of the oil pan. Unscrew the large plug, bringing the strainer with it. Wash thoroughly in gasoline. Reassemble completely and tightly, using a new gasket, if available. Fill the crankcase to the FULL mark with the proper S.A.E. number lubricating oil.

MAGNETO

Remove the screw-slotted oil plugs on the nameplate side of the magneto and lubricate with S.A.E. 10 oil every 500 operating hours. Replace the plugs.

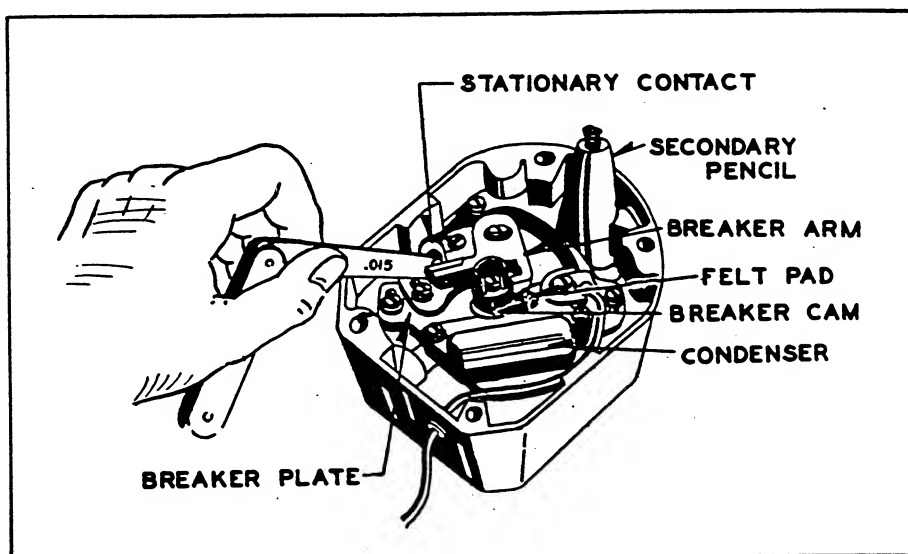
If the spark is weak, the magneto should be checked. The spark should jump at least 3/16" when the spark plug end of the cable is held that distance from the base of the spark plug while the engine is being cranked.

Disconnect the cable shields from the magneto shield. Pull the cables from the distributor, noting the position of each so it may be connected to its proper tower when reassembling. Lift the shield from the magneto.

DISTRIBUTOR.— Unscrew the distributor cap screws enough to remove the cap. Remove the cap and wipe it clean. If it is cracked, shows evidence of arcing or has corroded high-tension inserts, a new cap should be installed. Pull the distributor arm up off the breaker cam. Wipe it clean. If the spring is broken or the metal segment is too short, indicated by a burned condition on top of segment, a new distributor arm should be installed.

BREAKER MECHANISM.— Remove the breaker cover by prying it upward. Breaker contacts eventually become pitted and eroded. Examine them. They should be clean, free of pits and pyramids and in alignment. If not too bad they may be resurfaced by using a small, file-like carborundum hone. Use care to get them square. They may be cleaned with lacquer thinner and must be free of foreign material. After making sure that the contacts are in good order, the gap must be adjusted.

Remove the cover plate from the opening just ahead of the flywheel on the right side of the engine. Using a heavy screwdriver, engage the flywheel teeth and turn the flywheel backward until the magneto breaker arm rides on a high cam surface and contacts are open wide. Check the gap between contacts with a thickness gauge. The gap should be .015". To adjust, loosen the screw which holds the stationary contact bracket and move the bracket the proper amount by turning the eccentric headed screw in the open slot of the bracket. Tighten the holding screw and recheck the gap. Place a very small amount of light grease along the felt pad which lubricates the cam surface. Place one drop of S.A.E. 10 oil on the breaker arm pivot. If the contacts are found to be badly burned and somewhat sooty in appearance, and the spark weak and yellow, a new condenser probably is needed.



CHECKING MAGNETO BREAKER CONTACT GAP

REASSEMBLY.— Install the breaker cover, tapping it down onto the shoulders on which it sets. Place the felt washer on the four prongs of the breaker cover. Line up the key inside the distributor arm with the slot in the cam and press the distributor arm down into place. Make sure the distributor cap gasket is in place and install the cap. Install the magneto shield. Install the cables, each in its proper tower and push them well down into place. Install the shield nuts.

SPARK PLUGS.— Remove the spark plugs. Clean them, if needed, and inspect for cracked or badly eroded porcelains or badly eroded electrodes. Discard any spark plugs not in good condition and replace with new ones of correct type, Champion H-9. Adjust the gaps to .030". When installing, make sure the gaskets are in place. Tighten securely.

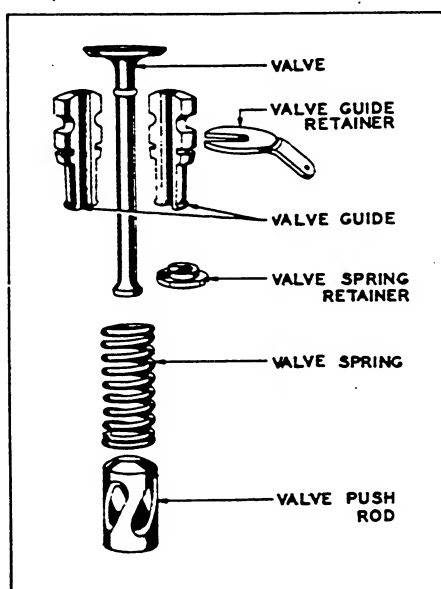
MAINTENANCE AND REPAIR

Eventually it may become necessary to grind valves, remove carbon, and make major repairs on the power unit. Major repairs should be attempted only by a mechanic thoroughly familiar with automotive type engines.

Before disassembling a portion of the power unit for repairs, a careful analysis of the existing conditions should be made to determine whether or not such disassembly is necessary.

The mechanic is better equipped by training and with tools than the operator. Therefore, whenever servicing a power unit, he should make all repairs that are required at the time, at least insofar as it is practicable to so do. Keeping the equipment in as good condition as practicable assures better performance, prolongs its life and actually reduces the major repairs ultimately required.

VALVE SERVICING



VALVE ASSEMBLY

Reduced engine power results from leaking valves which allow compressed gases to escape from the cylinder into the exhaust or intake manifold. By proper use of a cylinder compression gauge, leaking valves may be located. Compression gauge readings should be within 10 pounds of each other and not lower than 80 pounds at sea level. If testing equipment is not available, test compression as previously described.

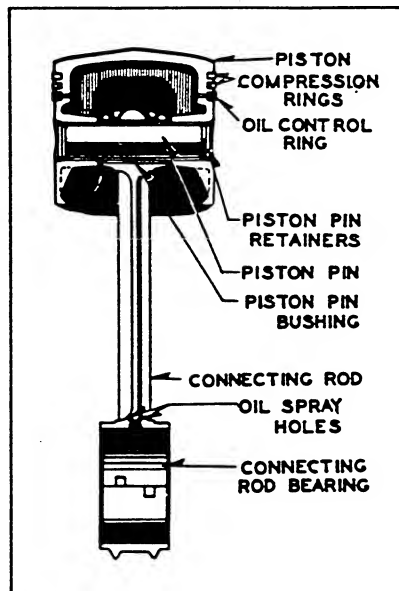
Maintain factory limits and clearances when grinding valves. Proceed as follows:

1. Drain the radiator.
2. Disconnect the fuel line at the carburetor.
3. Remove the air cleaner, air cleaner tube and bracket assembly.
4. Disconnect the throttle control rod and the choke control from the carburetor.

5. Disconnect the exhaust pipe and remove the manifold.
6. Remove the spark plugs and disconnect the temperature gauge thermal element from the cylinder head.
7. Remove the upper radiator hose.
8. Remove the cylinder head nuts holding the spark plug cable conduit and lay the conduit aside without disconnecting the cables from the magneto.
9. Remove the cylinder head and the valve spring covers.
10. Insert a small pry bar through the port at the side of the cylinder block and pry downward on the top of a valve guide. Be sure the valve is closed when prying down on the guide. After removing the retainer, remove the tool. Then remove the valve, guide, and spring assembly upward. Remove all valve assemblies and keep them in order so each may be reinstalled in its respective position.
11. Remove springs and guides from valves. Keep the 2-piece guides in pairs, each with its proper valve.
12. Remove carbon and corrosion from valves and guides. Clearance of stem in guide should be between .0015" and .0035". If the inside of guide has worn larger than .314", discard it.
13. Reface valves to 45° angle with an approved refacing machine. Discard valves that have been refaced until edges are thin, and valves with stems so worn that clearance is excessive when tested in a new guide.
14. Clean all carbon from the valve seats and ports and from tops of pistons. Clean the entire top of the cylinder block carefully.
15. Examine the valve seat inserts. Reface, if necessary. Eccentric grinding is the only method recommended for refacing the hardened seat inserts. Follow instructions furnished with the grinder. The seat width should not exceed 3/32".
16. Assemble each valve assembly and grind each valve in its proper seat with fine valve grinding compound, just enough to assure correct seating contact between valve and seat. Clean the grinding compound thoroughly from all parts.
17. Assemble the valves to the engine, then check the clearance between each valve and its tappet when the tappet is entirely down. The clearance must be between .013" and .015" for exhaust valves, or between .010" and .012" for intake valves. Adjustment is made by grinding either the valve face or the bottom of the stem, as required, on an approved valve grinding machine. If a valve face is ground, touch it up with grinding compound again as described above. Again remove all abrasive, install the valve assemblies and the valve spring covers, using new gaskets.

18. Clean all carbon from cylinder head and clean the gasket surface. Install the cylinder head, using a new gasket without cement. Tighten all nuts to a tension of 50-ft. lbs. with a torque indicating wrench.
19. Complete the entire reassembly, reversing the order of procedure used in disassembling. Clean all gasket surfaces and use new gaskets. Clean spark plugs and adjust gaps to .030" before installing. Service the carburetor before installing. Service the distributor and breaker mechanism of the magnetoe. Check the ignition timing before starting the engine. Install new radiator hose, if needed, and make sure that the thermostat is installed with arrow pointing toward the radiator.
20. Close the drain cock and fill the radiator.
21. Start the power unit and allow it to operate without load until normal operating temperature is reached. Adjust the carburetor. Check frequency; if necessary, adjust the governor.

CONNECTING ROD AND PISTON ASSEMBLY



PISTON AND CONNECTING
ROD ASSEMBLY

After draining the radiator and the oil pan, the cylinder head, oil drain assembly, and oil pan may be removed. Before removing the oil pan, the power unit should be set over a suitable pit or upon suitable and safe blocking to hold it high enough above the floor to afford easy access.

Inspect connecting rod bearings for looseness. If needed, new bearing inserts should be installed. After removing the bottom halves of the bearings, remove the piston and connecting rod assemblies from above. Replace the lower halves of bearings on their respective connecting rods. Connecting rods are numbered on the camshaft side of the bearing end.

Examine the cylinder bores. If required, install new cylinder sleeves. Examine the pistons. If they are considerably scored, are excessively loose in the cylinders, have excessively worn ring grooves, or otherwise are not in good condition, install new pistons. Install new pistons if the old ones are so loose on the piston pins that the condition cannot be corrected by using new .002" oversize piston pins.

If new cylinder sleeves are installed, use new piston rings with them. If the old sleeves are retained, it may be possible to use the old piston rings. Check the old piston rings for clearance in grooves, fit to cylinder walls, and tension when gap is closed. Good fit to cylinder walls is evidenced by a smooth, bright appearance on the entire exterior surface of the ring. Discard rings not meeting these tests.

Refer to the Table of Clearances in the fitting of new parts.

If the same pistons or rings are to be used, remove the rings from the pistons, being careful not to permanently distort the rings. Keep in such order that each ring will be installed in its same groove and with same side up as before removing. Clean all carbon from rings and pistons, giving particular attention to cleaning ring grooves, oil return holes and the chamfer at bottom ring groove.

Examine the fit of piston pins in connecting rods and pistons. If too loose, it may be possible to correct by installing new piston pins .002" oversize. This will require reaming the piston and the connecting rod bushing. The connecting rod bushing is not replaceable in the connecting rod.

The piston pin should drop through the piston pin hole in the piston with a maximum clearance of .0005", assuming that parts are clean and of same temperature. Pins float in connecting rod bushings and should be fitted .0001" loose.

Before installing a piston and connecting rod assembly in the engine, check its alignment, using an approved aligning fixture according to the manufacturer's instructions. Realign, if needed.

CYLINDER BORES AND PISTON FITTING

The cylinders are equipped with hardened, removable sleeves. Under normal conditions these sleeves seldom need replacing. Being hardened, they resist wear and scoring. If more than .005" out of true it is advisable to install new sleeves. Operating without proper lubrication may score the sleeves. Overheating of the engine due to lack of water may warp one or more of the sleeves, particularly at the top flange. Then carbon building up under the warped flange, may further distort the upper part of the sleeve. Install a new sleeve to correct this condition.

Cylinder sleeves may be removed and installed by using a Cylinder Sleeve Puller and Replacer tool according to the manufacturer's instructions.

Due to necessary tolerances in manufacture, the fit of new pistons in newly installed sleeves should be checked carefully. It is advisable to use a piston pull scale in fitting the pistons and fit to a pull of 7 to 12 pounds using a .003" thick feeler blade 0.50" wide.

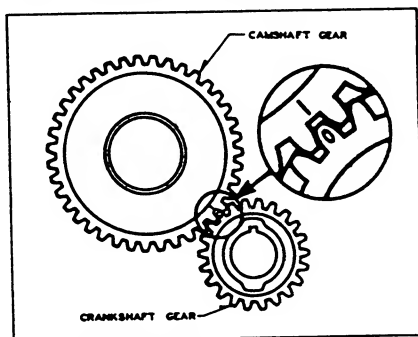
CRANKSHAFT

The crankshaft is supported by three bearings of the replaceable insert type. Several undersizes are available. The inserts are clamped in place by the bearing caps. End thrust is taken by the flanges of the center bearing. Oil flowing from the rear of the bearing is deflected into the oil pan by the oil-slinging flange on the crankshaft. A woven asbestos packing is fitted into grooves in the upper part of the oil seal and in the oil pan to prevent the escape of oil at that point. The packing is in two renewable pieces.

CAMSHAFT, VALVE TAPPETS AND TIMING GEARS

The three hardened journals of the camshaft are supported directly in bearing holes bored in the cast iron cylinder block. End thrust is taken on the face of the front bearing end. The camshaft and tappets seldom require replacing

To remove the camshaft and gear assembly, remove the cylinder front cover and the valve chamber cover plates. Then remove the valve guide bushing retainers and insert one of these parts in a slot in each of the tappets to hold the tappets up while the camshaft is being removed.



TIMING GEAR MARKS

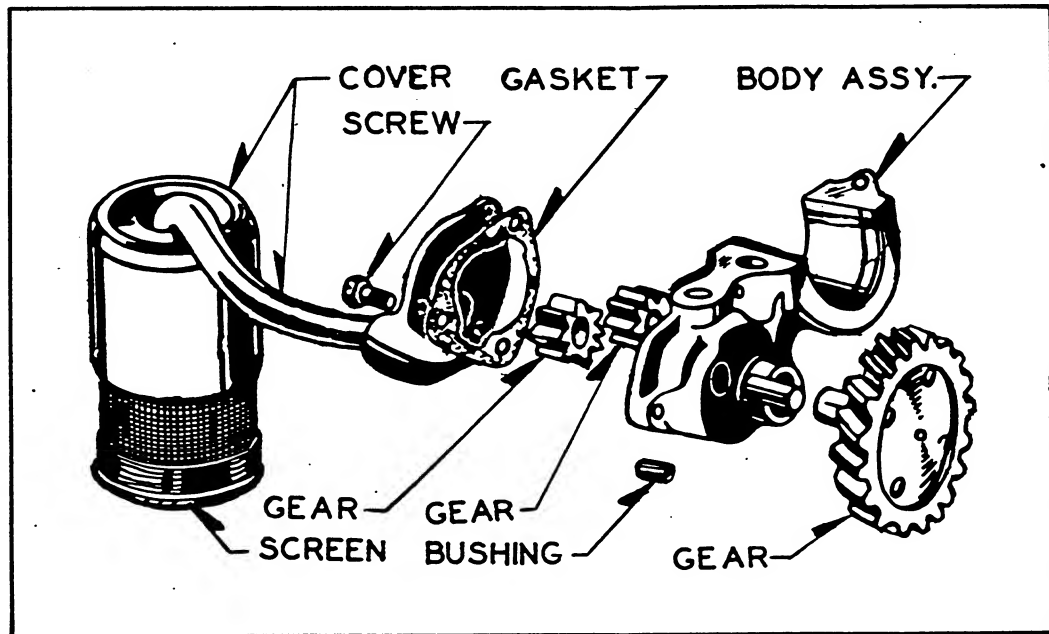
When assembling the engine, the timing marks on the timing gears must be aligned. The proper backlash is .003" to .004".

An off-center slot in the front end of the camshaft engages a corresponding tongue on the magneto adapter shaft and thus the magneto adapter shaft is driven. Forward thrust of both shafts is taken by a screw type adjustment extending through the cover of the adapter. Proper adjustment is obtained on the completely assembled engine by turning the adjustment in until all endwise slack of the shafts is taken up and then backing it out 1/8 turn and tightening the locknut securely.

FUEL SYSTEM

The fuel system includes the fuel tank, fuel pump, carburetor, and connecting fuel lines. The most important servicing it requires is to keep it free of dirt, water, and leaks. This requires care in handling of the fuel to avoid getting dirt or water into the fuel system, and periodic cleaning of sediment bowl and strainer to keep dirt and water which enter from reaching the passages and jets of the carburetor. Fuel leaks should be corrected as soon as discovered.

OIL CIRCULATING SYSTEM.— The oil pump housing is integral with the front main bearing cap, and the pump is driven by a fibre gear which meshes with the crankshaft timing gear. The pump is of the gear driven type. It may be disassembled by removing the cover at the rear of the pump housing. The parts are replaceable.



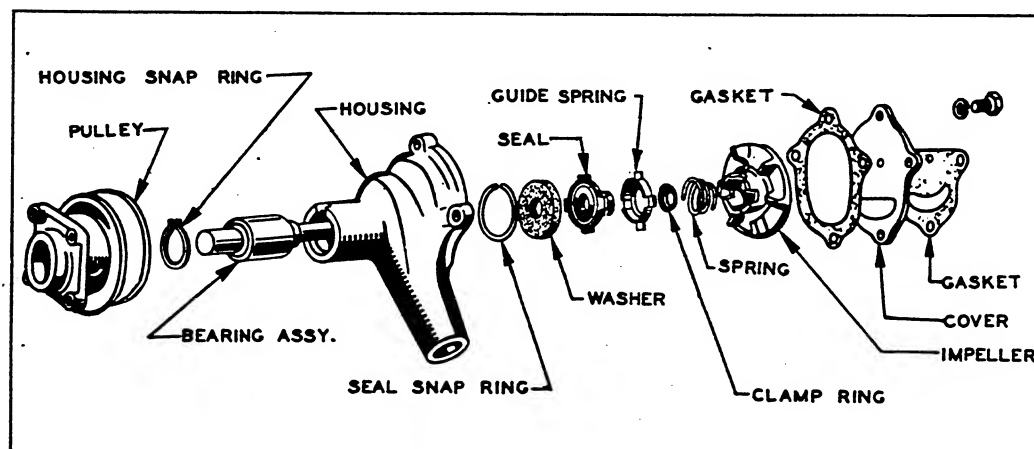
OIL PUMP ASSEMBLY

The oil screen is removable with the oil pan drain plug.

The oil relief valve spring and plunger may be removed after removing the relief valve nut. This valve seldom needs attention. It regulates the oil pressure and this pressure is registered on the OIL PRESSURE gauge. Normal gauge reading at normal operating temperatures is approximately 25 to 30 lbs. per square inch. Before attempting to correct the oil pressure by stretching the relief valve spring to increase pressure, or shortening the spring by grinding, to decrease pressure, be sure the incorrect oil pressure is not due to some other cause.

WATER PUMP.— To disassemble the pump after it has been removed from the engine, just remove the cap screw, cover and gasket. Press the pulley off the shaft in an arbor press, using a fixture which will hold the pulley at the belt groove. Remove the housing snap ring. Press the shaft from the impeller. Remove the seal snap ring and disassemble the various parts from the impeller.

Some metal is removed from the shaft and the holes in the impeller and the pulley when they are disassembled. If these same parts are to be used again, check them carefully to be sure they will fit tightly when reassembled. If doubtful, use new parts. Assemble the spring, clamp ring, seal, spring guide, seal washer, and snap into the impeller. Insert the shaft and bearing assembly into the housing and install the housing snap ring. Press the impeller assembly onto the rear end of the shaft. Press the pulley onto the shaft. Install the cover, using a new gasket. When installing the pump on the engine, use a new gasket.



WATER PUMP ASSEMBLY

MAGNETO

The magneto distributor breaker mechanism and condenser may be serviced while the magneto is on the engine.

BREAKER MECHANISM.— To remove the breaker contacts for resurfacing or for replacement, first remove the screws and washers from the breaker arm spring and pivot and lift the arm from the pivot. Remove the spacer and washer from the pivot. Remove the screw and washers from the end of the stationary contact bracket and lift the bracket off the pivot.

CONDENSER.— Remove the condenser. The condenser capacity should be .16 to .18 mfd. If not within these limits, install a new condenser. Place the condenser gasket in position before installing the condenser.

BREAKER PLATE GROUP.— If desired, the breaker plate, contacts, and condenser may be removed as a unit. To do this, disconnect the two leads from the breaker spring screw. Then remove the two breaker plate mounting screws, lockwasher, and plain washers and lift out the breaker assembly. The slots for the mounting screws permit shifting the position of the breaker plate. Witness marks on the plate and adjacent boss indicate the correct position.

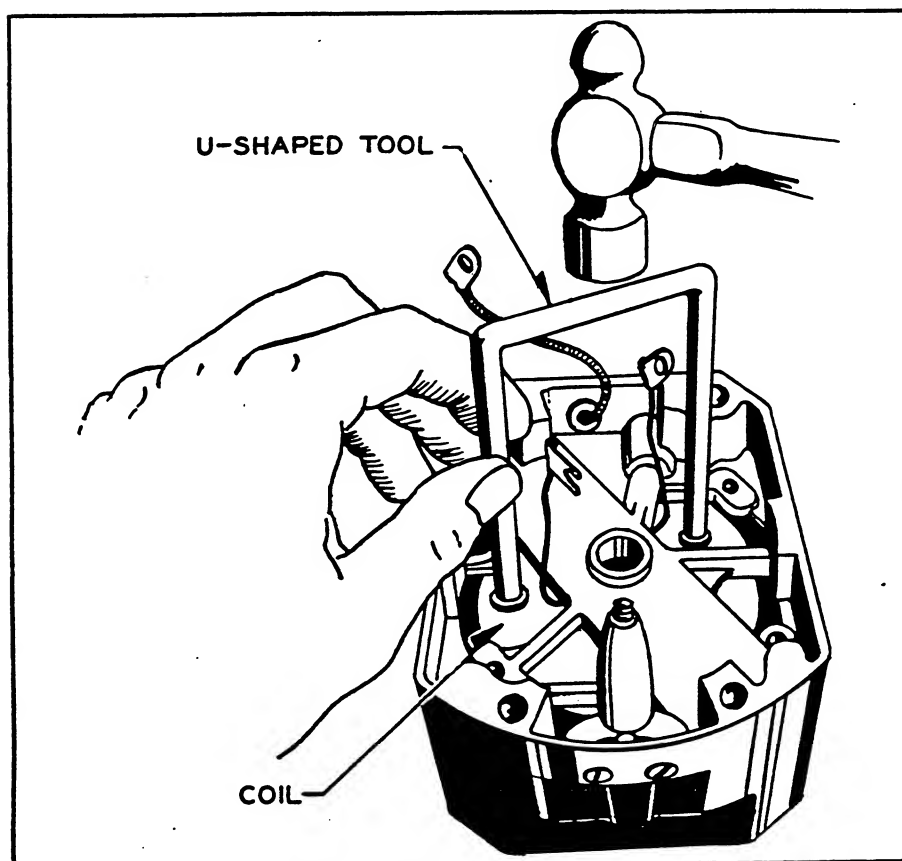
Test the coil without removing from the magneto. When using an Eisemann coil tester, connect the tester ground lead to the magneto housing, connect the tester breaker lead to the magneto ground terminal, connect the tester spark lead to the spring of the magneto secondary pencil. Turn the cam until the breaker points are open. Replace the coil with a new one if it requires more than 1.5 amperes to give a steady spark on a 5 mm. gap.

MAJOR MAGNETO REPAIRS.— Major magneto repairs require removing the magneto from the engine. Loosen the bolt of the magneto clamp and lift the magneto from the adapter mounting.

Remove the distributor cap, distributor arm, breaker cover, and breaker plate group as already described. The remainder of the magneto may be disassembled as follows:

1. Remove the screw, lockwasher, and lock plate from the cam and pull the cam from the shaft. If it sticks, tap lightly with a piece of brass rod while pulling.

2. Remove the two bearing plate clamp screws and pull the bearing plate, rotor, end plate, and impulse coupling from the housing as a unit. The screws must be unscrewed a little at a time as the bearing plate separates from the housing.
3. Pry out the inner core snap ring. Press the coil away from the inner core just enough to permit inserting the ends of two screwdrivers (180° apart) under the edge of the inner core. Carefully pry the inner core out.
4. Disconnect the coil ground terminal. Arrange the leads so they will not catch on the housing. Use a Wico tool No. 4086 or similar inverted U-shaped tool to remove the coil. Insert the



REMOVING MAGNETO COIL

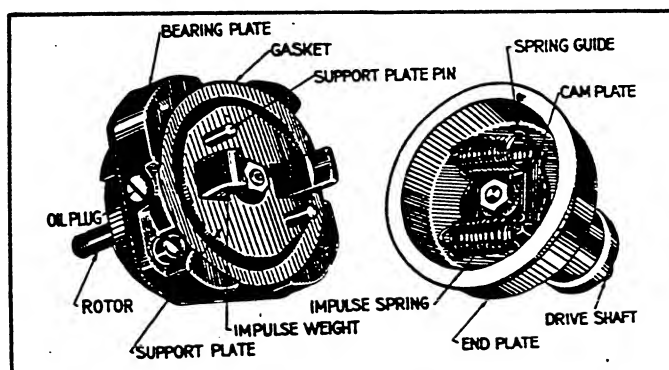
legs of the tool through holes in the upper end of the housing so they will rest on the coil on opposite sides of the laminated core. Strike the tool with a light hammer and drive the coil out, being careful not to injure the insulation.

5. Remove the two screws and lockwashers which hold the secondary pencil. Then remove the pencil.
6. Using a 3/32" pin punch and light hammer, drive the pin from the gear while supporting the gear at the shoulder. Pull the gear

from the shaft. Remove the snap ring from the shaft. Remove the screws and clamp washers which hold the end plate to the bearing plate. Strike the side of the end plate lightly with a mallet to loosen it from the bearing plate. While pushing against the end of the drive shaft, pull the end plate off the shaft. Then pull the drive shaft with cam plate and impulse springs from the support plate.

7. Clamp the cam plate in a vice and remove the nut and washer. Replace the nut loosely and tap it lightly to loosen the shaft. Remove the nut and then remove the shaft.
8. Remove the nut and washer which hold the support plate to the rotor shaft and pry the plate from the shaft by using two screwdrivers 180° apart. Pull the rotor from the bearing.
9. Remove the cotter pins from the impulse weight pivot pins. Remove the pivot pins and the weights. Note the positions of the impulse weight springs and install them in their correct positions when reassembling.

When disassembled, all parts may be inspected and necessary new parts substituted. Reassembly is made by reversing the procedure used in disassembly, giving special attention to certain details. Place a few drops of oil on the bearing surfaces before assembling. Make sure there is a good contact between the secondary pencil and the secondary clip on the coil. Press the coil down and insert the wedges on the same side of the core as the split in the core.



MAGNETO IMPULSE COUPLING

When reassembling the impulse mechanism, hook the ends of the impulse springs properly over the pins on support plate and cam plate. Place the gasket in position and slide the end plate over the drive shaft to proper position. Align the witness marks on end plate and bearing plate before tightening the holding screws.

Peen the ends of the gear pin.

Make sure that the oil plug in the bearing plate is on the same side as the one in the body. Turn the screws in, a little at a time, as the parts come together. Tighten securely.

The indicating marks should line up when the breaker plate is installed. If a new breaker plate has no indicating mark, set it at such position as provides the best spark when tested at 65 r.p.m. on a test stand. After locating the correct position, mark it permanently with a chisel mark on the end of the breaker plate and the adjacent boss.

Test the secondary current. Taken through the distributor cap, it should jump a No. 4 star gap or a 9/32" needle gap at 65 r.p.m., a No. 5 star gap of 11/32" needle gap at 150 r.p.m. If a star or needle gap is used with an Allen or Weidenhoff test stand, be sure the gap is properly grounded to the stand.

Remove the two oil plugs and fill the holes with S.A.E 10 oil. Reoiling should not be necessary oftener than each 500 operating hours unless disassembled in the meantime.

TIMING MAGNETO TO ENGINE.— Remove the No. 1 spark plug and adapter fitting from the engine. Insert a bent piece of stiff wire through the spark plug hole into the cylinder far enough to feel the near edge of the piston as it rises. Crank the engine slowly and stop when the piston is exactly at top dead center on a compression stroke. Then grasp the magneto gear and turn it in the normal direction of rotation until the impulse coupling has just tripped and the metal segment of the distributor arm is near the position corresponding with the No. 1 tower of the distributor cap. Install the magneto and tighten the locking clamp.

Recheck the timing by cranking the engine until the No. 1 piston again reaches the top of the compression stroke. The impulse coupling should just snap at this piston position. The timing should be rechecked under running conditions. Make final adjustments by slightly turning the magneto housing to advance or retard the spark to the position which gives best engine performance. Tighten the clamp screw securely.

CLEARANCES AND TOLERANCES

TABLE OF CLEARANCES AND TOLERANCES

Firing Order..... 1-2-4-3	Piston Rings:
Cylinder Bore..... 3.187"	Width:
Removable Cylinder Sleeve. Yes	Top Compression... .0940" - .0950"
Stroke..... 3.75"	Center Compression
Compression Ratio..... 6.1:10935" - .0945"
Cylinder Head Bolt Tension	Oil Control..... .1565" - .1575"
..... 50 Ft.-Lbs.	Groove Clearance:
Valve Seat Angle..... 45°	Top..... .002" - .0035"
Valve Seat Width, Max... 3/32"	Other..... .0015" - .002"
Exhaust Valve Clearance	Gap Clearance..... .012" - .017"
..... .013" - .015"	Connecting Rod Bearings:
Intake Valve Clearance	Type:
..... .010" - .012"	Steel-backed, Alloy-lined, replaceable
Valve Clearance in Guide	Diameter..... 2.094"
..... .0015" - .0035"	Diameter Clearance
Valve Spring Length:0004" - .0025"
Free..... 2.41"	Selected..... .0000" - .0025"
Under 63 Lbs..... 1.84"	End Clearance..... .004" - .008"
Camshaft Bearing Clearance	Piston Fitting:
..... .0015" - .0032" 7 to 12 lbs. pull on .003"
Piston Pins:	feeler gauge 0.50" wide.
Diameter..... .7501 - .7504"	Main Bearings:
Fit in Piston..... .0005"	Type:
Fit in Rod..... .0001" Loose	Steel-backer, Alloy-lined, replaceable
Oversize available .002"	Diameter 2.2435"
	Diameter Clearance .000" - .0025"
	Timing gear Backlash .003" - .004"

GENERATOR

GENERAL

The generator normally requires little servicing other than periodic attention to the brushes, commutator, slip rings and ball-bearings. Eventually the commutator bars wear down so that the mica must be undercut. This should be done as soon as the mica on any part of the commutator surface touches the brushes. To do this operation properly will require removing the generator end bell and, for that reason may be considered a major service operation. The method of disassembling the power unit for major generator service is explained in the next few paragraphs. The disassembly need be carried only to the point which permits the necessary work to be done.

When it becomes necessary to remove a major part of the generator, the housing rear end panel must be removed first. Tag all wires as they are removed to assist in properly connecting them when reassembling. After disconnecting the power lines, removing the battery charging generator, and the outlet box, remove the bolts which attach the rear end panel to the housing side panels. Lift the rear end panel from the housing.

REMOVING EXCITER FRAME

After removing the rear end panel, etc., as described in the preceding paragraph, the exciter end bell and exciter frame assemblies may be removed. Proceed as follows:

1. Remove the exciter end bell band. Lift all brushes high in their holders and set the ends of the springs against them to hold them high.
2. Remove the generator bearing cover. Remove the screw and clip which hold the outer race of the generator bearing from turning.
3. If the entire generator frame is to be removed, omit the next three operations and proceed to the operations under the next paragraph.
4. Disconnect the field leads from the brush rig.
5. Remove the cap screws which hold the exciter to the generator frame. Remove the exciter end bell.
6. If the exciter field assembly is to be removed, untape the group of lead wires and separate the exciter series field lead from the a-c leads. Then remove the exciter frame. It may be tapped on either side to break the joint. Then insert small prying bars in the joint at opposite sides of the frame and complete the removal.

SUPPORTING THE ROTOR

After the end bell of the complete generator frame is removed, the rotor has no rear support and care must be used to avoid placing any weight on this exposed end. At whatever stage the disassembly is stopped, place wood blocking under the bearing end of the rotor shaft to carry the weight

GENERATOR

of the rotor. To leave it unsupported for a considerable time may result in distorting the shaft. Do not put blocking under the commutator or slip rings.

REMOVING GENERATOR

After removing the rear end panel, etc., as described in a preceding paragraph, the generator frame may be removed. Proceed as follows:

1. Remove the cover band from the exciter. Lift all brushes high in their holders and set the ends of the springs against them to hold them high.
2. Remove the generator bearing plate. Remove the screw and clip which hold the outer race of the generator bearing from turning.
3. Loosen the upper radiator hose connections. Drain the oil from the power unit oil pan and remove the oil drain fittings.
4. Remove the screw from the top center of the generator frame and screw in a substantial eye-bolt with which to lift the generator. The thread is 1/2"-13.
5. Attach a hoist to the eye bolt and support the weight of the generator without lifting the housing from the floor. Remove the cap screws which attach the generator frame to the housing side panels. Raise the generator slightly and place substantial blocking under the generator adapter. Lower the weight on this blocking to make sure it will support the generator at approximately its normal position in the housing. Be careful not to raise the generator so high as to cause damage to the radiator connections or to jam against the radiator core.
6. Again support the weight of the generator with the hoist but do not raise the housing. Remove the nuts from the studs which hold the generator frame to the generator adapter. Slide the generator frame assembly to the rear until it clears the rotor assembly. Be careful that the generator frame assembly does not ride on the rotor assembly as it is being removed.
7. If the rotor assembly is not to be removed, support the bearing end of the rotor on blocks just high enough to support its weight without distorting the shaft.
8. If the rotor is to be removed, attach a rope around the shaft near each end of the assembly and support its weight with a hoist. Then remove the cap screws which attach the drive flange to the generator blower. Remove the rotor assembly from the flywheel carefully so as not to damage the pilot which fits in a recess in the engine flywheel.

ASSEMBLING GENERATOR TO POWER UNIT

Reassembly is accomplished by a reversal of the operations used in disassembly. Use care. Make sure that all contact surfaces between parts are clean before fitting together. Tighten all nuts, screws, and connections securely. Use lockwashers in all places where they were used

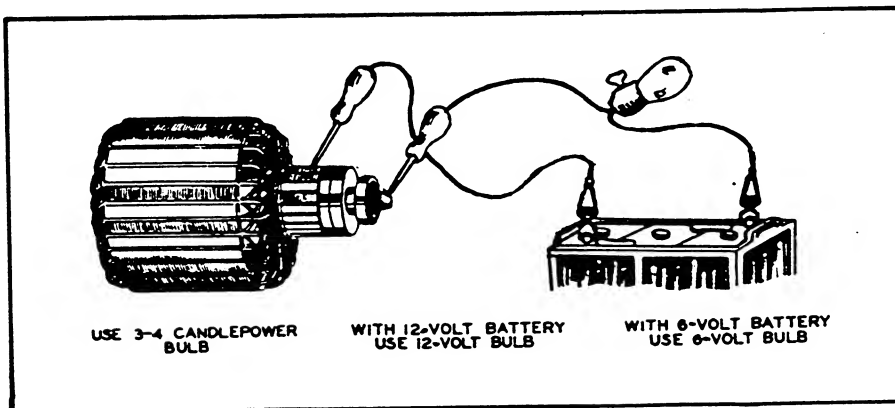
originally, preferable new lockwashers.

After tightening the cap screws which attach the rotor drive flange to the flywheel, use a dial gauge to check the alignment of the rotor. The run-out should not exceed a total of .010". To correct excessive run-out, turn by means of hand crank until high side is up. Grasp the end of rotor in both hands and push downward, but not too forcibly. Then test again. Repeat until total run-out as shown by dial gauge is within .010". Loosening and re-tightening the cap screws which attach the drive flange to the generator blower may help to correct excessive run-out.

Be sure to install the rear bearing lock, fitting it into the slot in the bearing race. Tighten the hose clamps, after the generator frame is attached to the housing side panels. Before starting the power unit fill the radiator and check your reassembly carefully to make sure no operation has been omitted.

TESTING WINDINGS

A test lamp is required to make most of the test described here. A d-c voltmeter is required for some of the tests.



TEST LAMP

If an exciter armature winding or an alternator field winding tests open-circuited, short-circuited or grounded, the practical repair is to install a new rotor assembly. If the stator winding tests open-circuited, short-circuited or grounded, the practical repair is to install a new stator winding assembly unless the trouble is in the leads outside the winding proper.

If a winding having external leads, tests defective, check the leads carefully. If the trouble is in a lead, it can be repaired as the nature of the trouble requires.

Before starting the tests, remove the cover from the exciter, lift all brushes high in the holders and set the ends of the springs against them to hold them high. Then disconnect the stator leads and the exciter cable from their terminal posts.

Test prods must make good electrical connections at points of contact.

TESTING EXCITER ARMATURE FOR OPEN OR SHORT-CIRCUIT.- This test requires the use of an armature growler after first removing the exciter frame.

TESTING ROTOR WINDINGS FOR GROUNDS.- Touch one test prod to the rotor shaft and the other to a collector ring. If the lamp lights, the alternator field winding is grounded. Touch one test prod to the rotor shaft and the other to the exciter commutator. If the lamp lights, the exciter armature winding or the commutator is grounded.

TESTING REVOLVING-FIELD WINDING FOR OPEN-CIRCUIT.- Touch one test prod to each collector ring. If the lamp does not light, the field circuit is open-circuited.

TESTING REVOLVING-FIELD WINDING FOR SHORT-CIRCUIT.- If a considerable number of turns in one coil are short-circuited, that coil will run cooler than other coils which are in good condition. Grounds at two points in the winding would short-circuit the intervening portion and the winding would test grounded.

TESTING EXCITER FIELD WINDINGS FOR OPEN OR SHORT-CIRCUIT.- Use the test prods to test for open-circuit. Test for short-circuit in the turns of a shunt coil by connecting the series of four shunt coils across a 6-volt battery and taking a voltage reading across each coil. If the voltage is lower on one coil than on the others, that coil has some turns short-circuited. To test for open-circuit, touch one test prod to each of the two ends of the series of four coils. If the lamp does not light, there is an open-circuit. Unless the trouble is located at connections between coils and easily repaired, install new coils.

TESTING EXCITER FIELD WINDINGS FOR GROUNDS.- Disconnect the shunt field lead near the upper left exciter brush holder and the series field lead near the lower left brush holder. Touch one test prod to the exciter frame. Touch the other test prod to any of the field leads. If the lamp lights, the winding is grounded. Inspect the leads. If the ground is in a lead, tape the defective section with two layers of half-lapped rubber tape, then with two layers of friction tape. If the ground is in the winding proper, the exciter field must be removed. Then remove the hollow-head screws which hold the field pole shoe to the frame. Remove screws from one pole shoe at a time, push the pole shoe and coil away from the frame and test again for ground. The ground is at the coil last loosened before the test indicates that the ground has been removed. Remove the pole shoe from the coil and locate the grounded spot on the coil by visual inspection. Install a new winding. If a new winding is not available it may be possible to repair the coil by taping the defective area with several layers of carefully half-lapped friction tape, then shellacing the area. Replace after shellac has dried.

TESTING STATOR WINDINGS FOR GROUNDS.- Touch one test prod to the stator frame. Touch the other test prod to the terminal of either stator winding lead. If the lamp lights, the stator winding is grounded.

GENERATOR

If the ground is in the winding proper, install a new stator core and winding assembly.

TESTING STATOR WINDINGS FOR OPEN OR SHORT-CIRCUITS.- The stator windings consist of two series of windings connected in parallel. An open circuit in one series would overload the other. At light and medium loads this might not be noticeable in performance. At heavy loads the voltage would drop somewhat below normal and if long continued, excessive heating would damage the insulation. A short-circuit would cause heating of the short-circuited coils, probably resulting in damage to the insulation. The voltage would drop, the amount of the drop depending on the location of the short-circuit. These conditions cannot be exactly located by test without removing the core and winding from the stator frame and opening certain connections. However, these conditions seldom occur and when they do occur, the damage usually is of such extent that it can be detected by a close visual examination of the winding. A new stator core and winding assembly is required to correct either condition. If such trouble is suspected, test other windings and check the generator and all external connections carefully before concluding that the stator windings are open-circuited or short-circuited.

SERVICE DIAGNOSIS

GENERAL

Before checking further, be sure that all wiring is properly installed, and that the power unit has been serviced with the proper grade of oil and fuel.

I. STARTER FAILS TO CRANK ENGINE

1. Discharged battery.
2. Corroded terminals.
3. Loose connections.
4. Engine stuck.
5. Defective starting solenoid switch.

II. ENGINE CRANKS TOO SLOWLY

1. Too heavy oil in crankcase.
2. Weak battery.
3. Corroded terminal.
4. Defective cable.

III. ENGINE CRANKS, BUT WILL NOT START

1. Faulty ignition.
2. Lack of fuel as faulty carburetor.
3. Poor compression, usually because of leaking valves.
4. Wrong timing.

IV. POWER UNIT RUNS BUT VOLTAGE DOES NOT BUILD-UP

1. Poor commutation.
2. Open circuit, short circuit or ground in generator or field circuit.
3. Poor seating of brushes on slip rings.

V. VOLTAGE UNSTEADY BUT ENGINE NOT MISSING

1. Poor commutation.
2. Loose connection.
3. Fluctuating load.
4. Voltage regulator not functioning properly.

VI. ENGINE MISSES AT LIGHT LOAD

1. Carburetor idle adjustment set wrong or clogged.
2. Intake air leak.
3. Faulty ignition.
4. Spark plug gaps too narrow
5. Uneven compression

VII. ENGINE MISSES AT HEAVY LOAD

1. Spark plugs defective.
2. Faulty ignition.
3. Clogged carburetor jets.
4. Clogged fuel screen.
5. Defective spark plug cables.

VIII. ENGINE MISSES AT ALL SPEEDS

1. Fouled spark plugs.
2. Defective or wrong spark plug.
3. Sticking valves.
4. Broken valve spring.
5. Defective ignition wires.
6. Defective or improperly adjusted magneto.

IX. LOW OIL PRESSURE

1. Oil too light.
2. Oil badly diluted
3. Oil too low.
4. Oil relief valve not seating.
5. Badly worn engine.
6. Sludge on Oil screen.
7. Badly worn oil pump.
8. Defective oil pressure gauge.

X. HIGH OIL PRESSURE

1. Oil too heavy.
2. Clogged oil passage.
3. Oil relief valve stuck.
4. Defective oil pressure gauge.

XI. POWER UNIT STOPS UNEXPECTEDLY

1. Fuel tank empty.
2. Defective ignition.

XII. ENGINE BACKFIRES AT CARBURETOR

1. Lean fuel mixture.
2. Poor fuel.
3. Intake valves leaking.
4. Spark too late.
5. Spark wires crossed.

XIII. EXCESSIVE OIL CONSUMPTION

1. Oil leaks from oil pan or connections. This does not cause smoky exhaust.
2. Oil too light or diluted
3. Bearing clearance too great.
4. Oil pressure too high.
5. Engine misses firing.
6. Faulty ignition..
7. Unit operated a great deal at light or no load.
8. Too much oil.

XIV. BLACK, SMOKY EXHAUST, EXCESSIVE FUEL CONSUMPTION, FOULING OF SPARK PLUGS WITH BLACK SOOT, POSSIBLE LACK OF POWER UNDER HEAVY LOAD

1. Fuel mixture too rich.
2. Choke not open.
3. Dirty carburetor air cleaner.

XV. LIGHT POUNDING KNOCK

1. Loose connecting rod bearing.
2. Low oil supply.
3. Low oil pressure.
4. Oil badly diluted.

XVI. DULL METALLIC THUD. If not bad, may disappear after a few minutes operation. If bad, increases the load.

1. Loose Crankshaft Bearing.

XVII. SHARP METALLIC THUD, ESPECIALLY WHEN COLD ENGINE FIRST STARTS

1. Low oil supply.
2. Low oil pressure.
3. Oil badly diluted.

XVIII. PINGING SOUND WHEN ENGINE IS RAPIDLY ACCELERATED OR HEAVILY LOADED

1. Carbon on cylinders.
2. Spark too early.
3. Spark plugs burned or carboned.
4. Valves hot.
5. Fuel stale or low octane.
6. Lean fuel mixture.

XIX. HOLLOW CLICKING SOUND WITH COOL ENGINE UNDER LOAD

1. Loose piston.

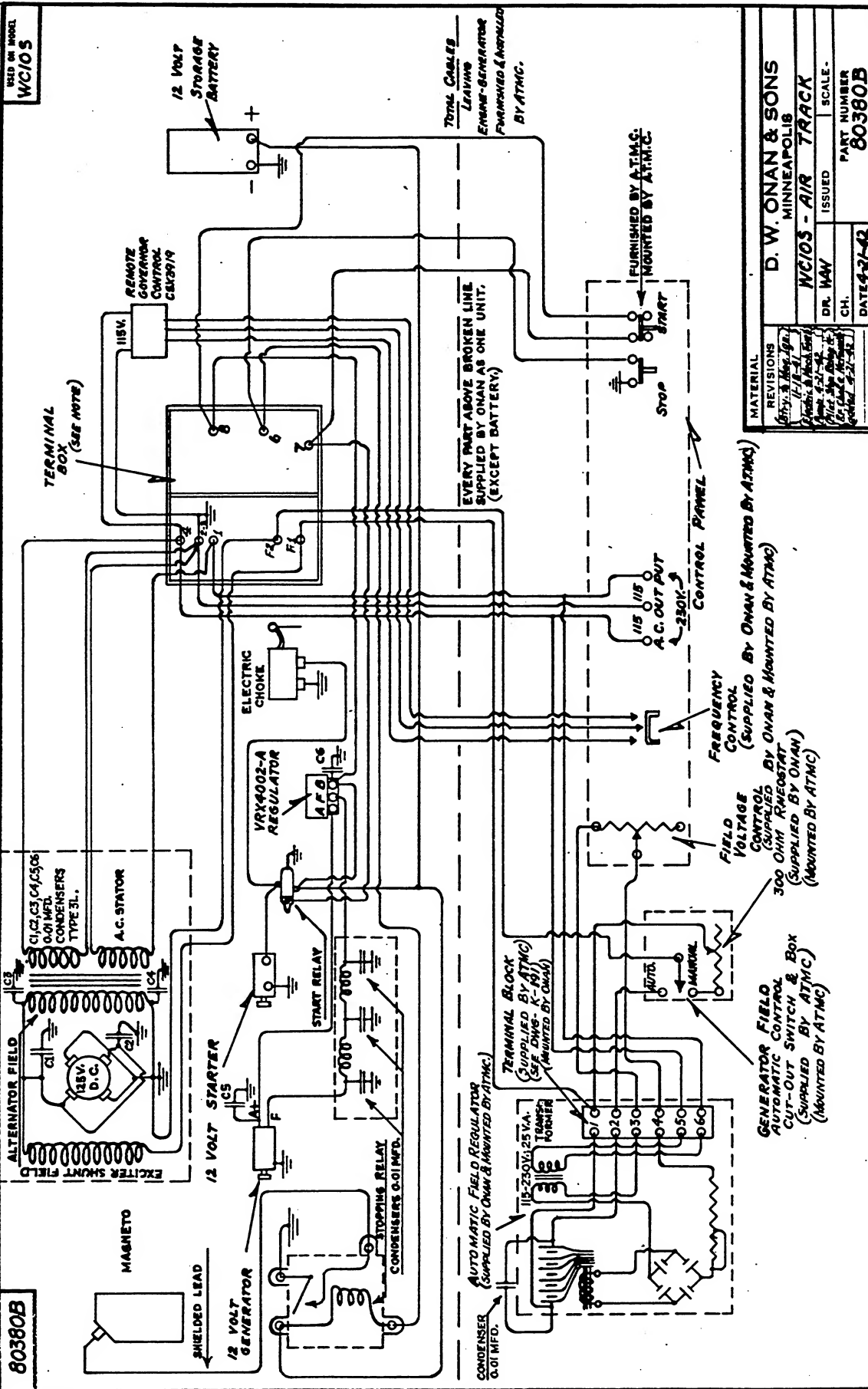
GENERATOR

I. OVERHEATING

1. Overloaded
2. Low power factor load.
3. Lack of ventilation

II. POOR COMMUTATION

1. Brushes not set at neutral position.
2. Brushes not fitted to the surface of commutator.
3. Brushes binding in holders.
4. Brushes not equally spaced around commutator.
5. Brush pressure insufficient.
6. Unequal brush pressure.
7. Brushes of an unsuitable grade.
8. Commutator bars loose or projecting above others.
9. High mica.





INSTRUCTIONS FOR ORDERING PARTS FROM FACTORY

If these instructions are followed when ordering parts, it will greatly speed up the handling of your order, and help us in rendering prompt and efficient service.

Be sure to state the MODEL NO. _____ SERIAL NO. _____ and GENERATOR NO. _____ of the particular ONAN PLANT for which parts are required. These numbers will be found on the name plate on the plant. Parts must be ordered by parts numbers and description as listed in catalog. Do not order parts in sets unless so cataloged. State the exact quantity of each part needed. State definite shipping instructions on your order - Parcel Post, Express or Freight.

If in doubt as to the part number or description, send the part to us by Parcel Post. Print your name and address plainly on the package so that it can be identified when received. All parts will be held until a letter of advice is received.

Write, stating the part or parts that are being returned and the purpose for the return, regardless of any previous correspondence. Glue the letter (which must bear a three cent stamp) to the outside of the package. Do not seal package.

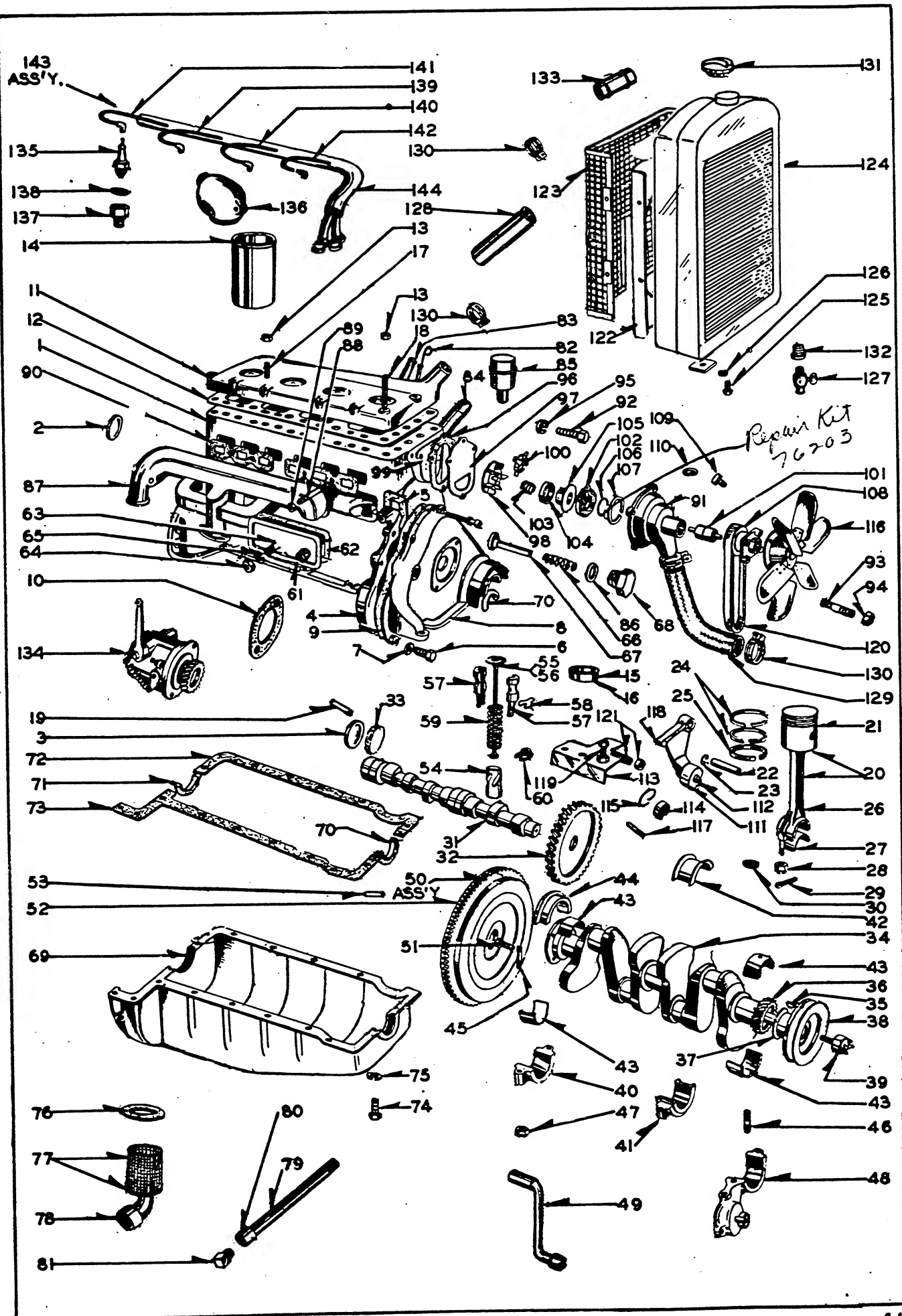
Please do not order parts in a letter in which some other subject is treated.

Send parts order to D. W. ONAN & SONS, addressing your letter as follows:

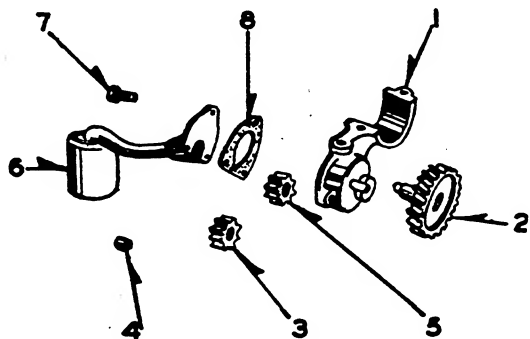
D. W. ONAN & SONS
43-51 ROYALSTON AVE.
MINNEAPOLIS 5, MINN.

All shipments are complete, properly packed and in good order when delivered to the transportation company. When a damaged shipment is received, claims should be filed immediately against the transportation company from which shipment has been received. All claims for shortages or errors in packing must be made immediately upon receipt of shipment, and must be accompanied by the original invoice or packing slip with the proper notation of damage or shortage signed by the transportation company at destination.

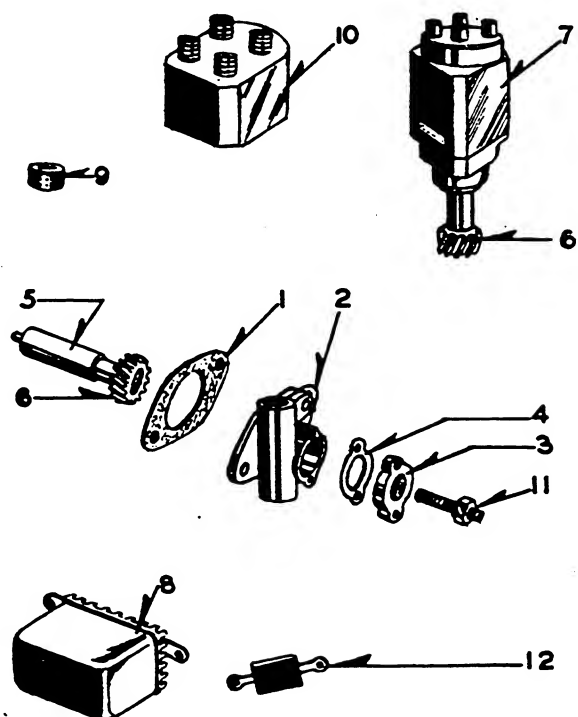
Parts prices quoted herein are F.O.B. factory and are subject to change without notice.



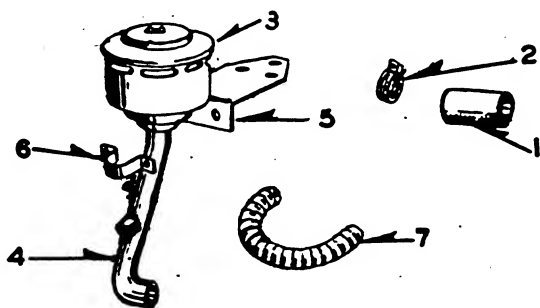
MAIN ENGINE PARTS



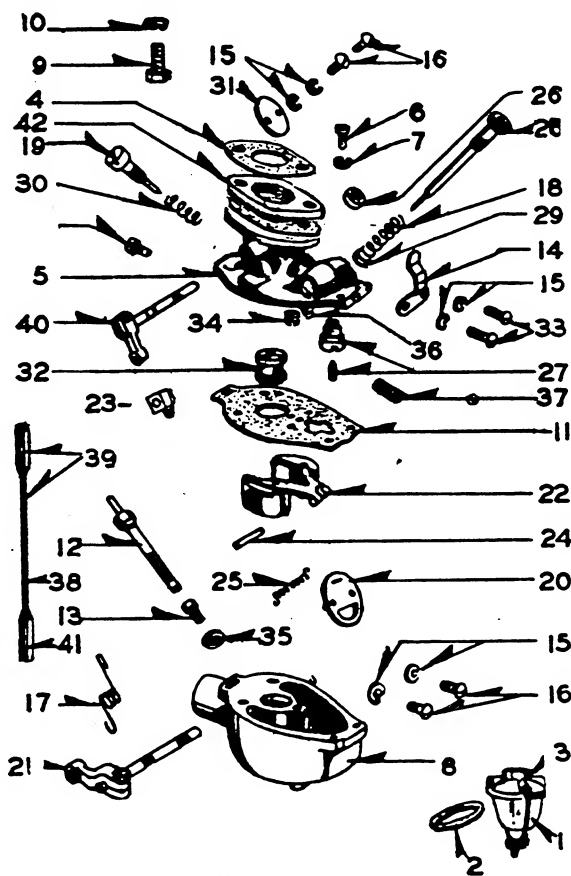
OIL PUMP GROUP



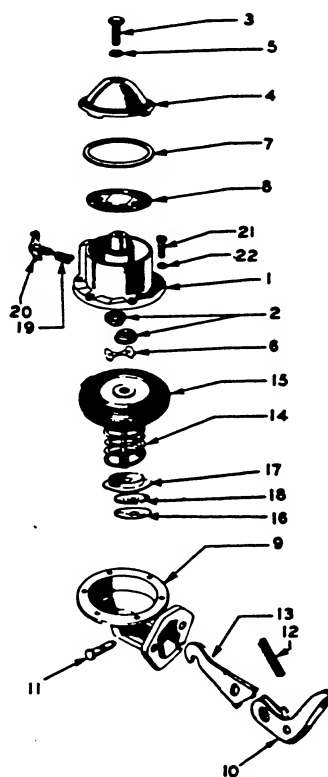
MAGNETO AND GEARCASE GROUP



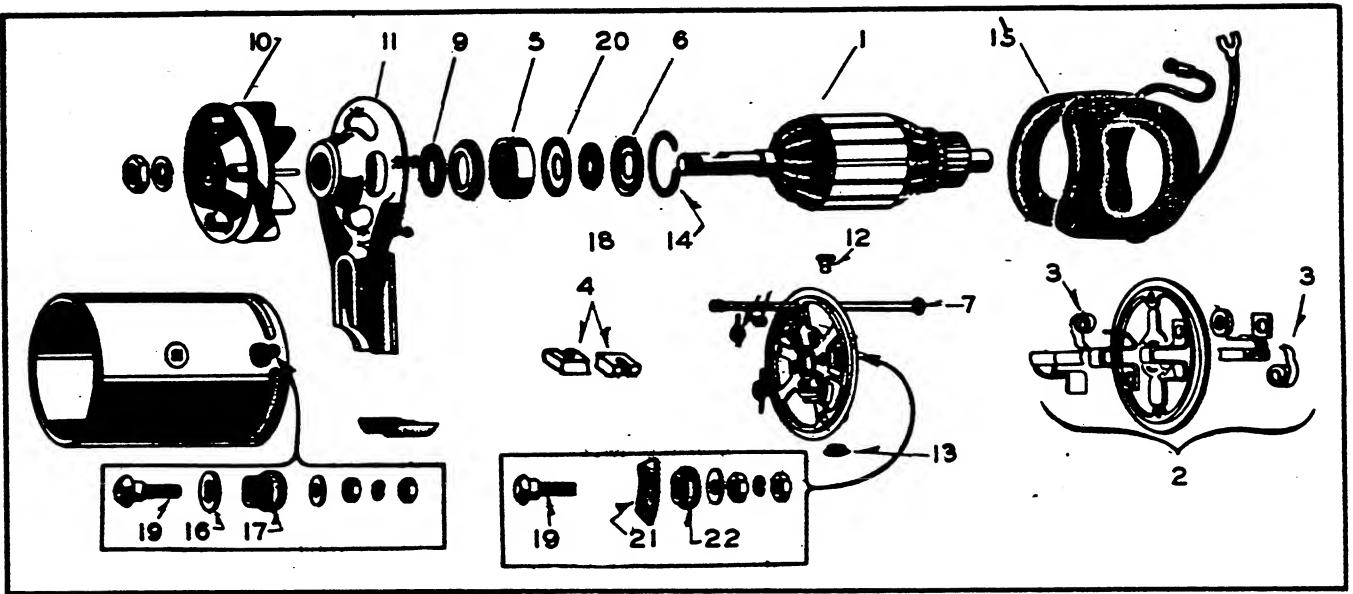
AIR CLEANER GROUP



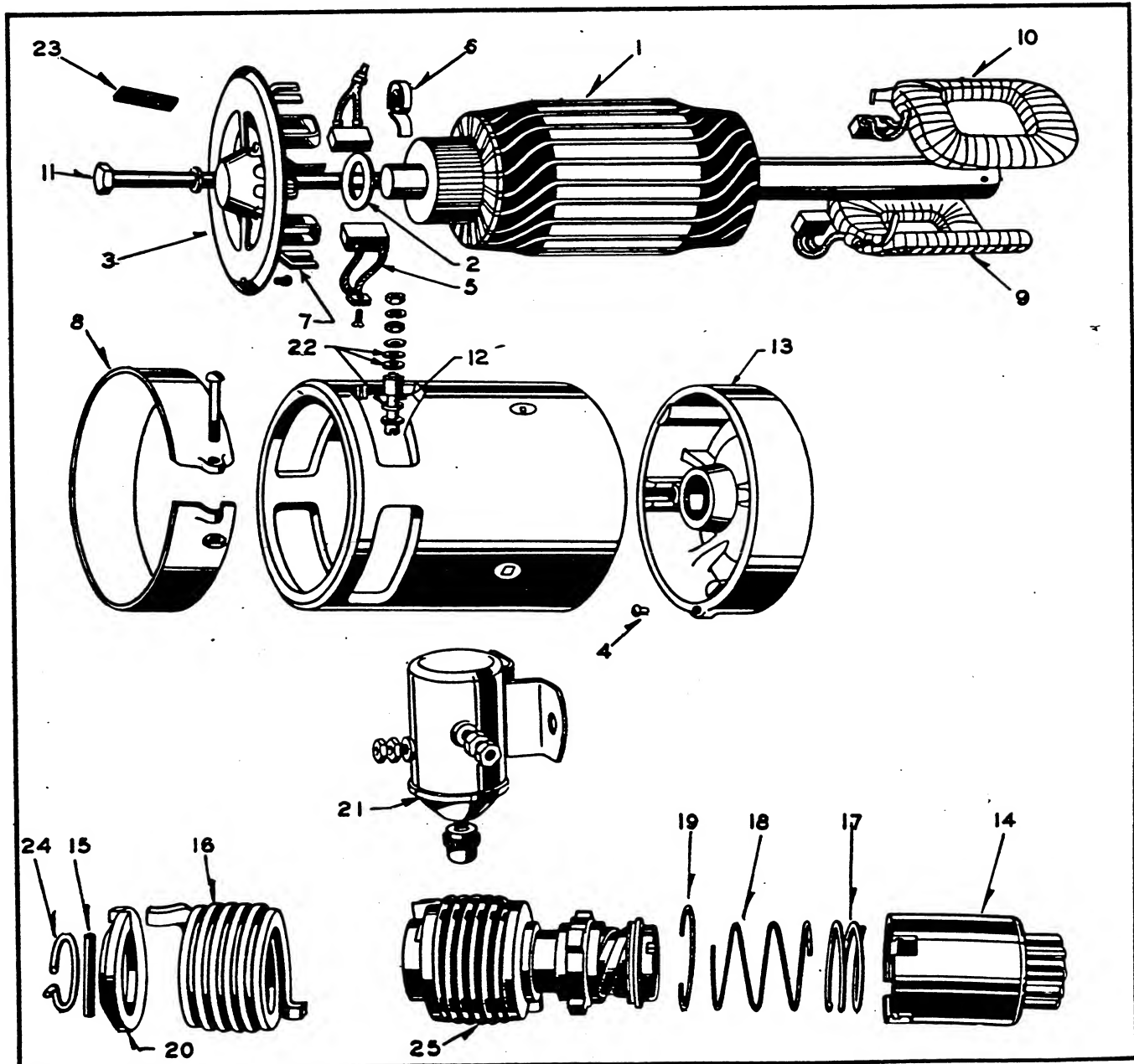
CARBURETOR AND FILTER GROUP



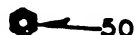
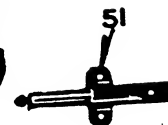
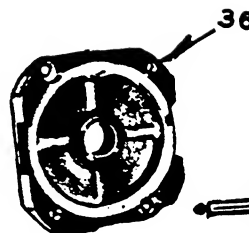
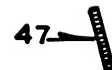
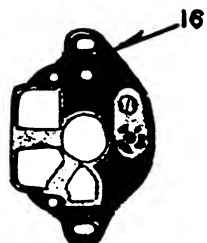
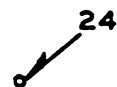
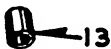
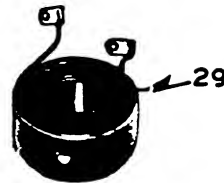
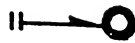
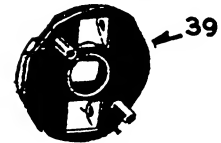
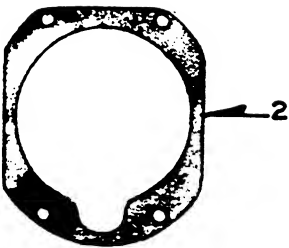
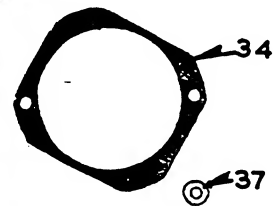
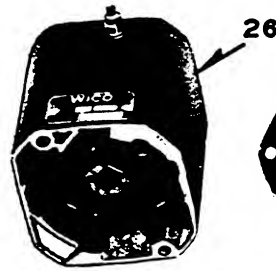
FUEL PUMP GROUP

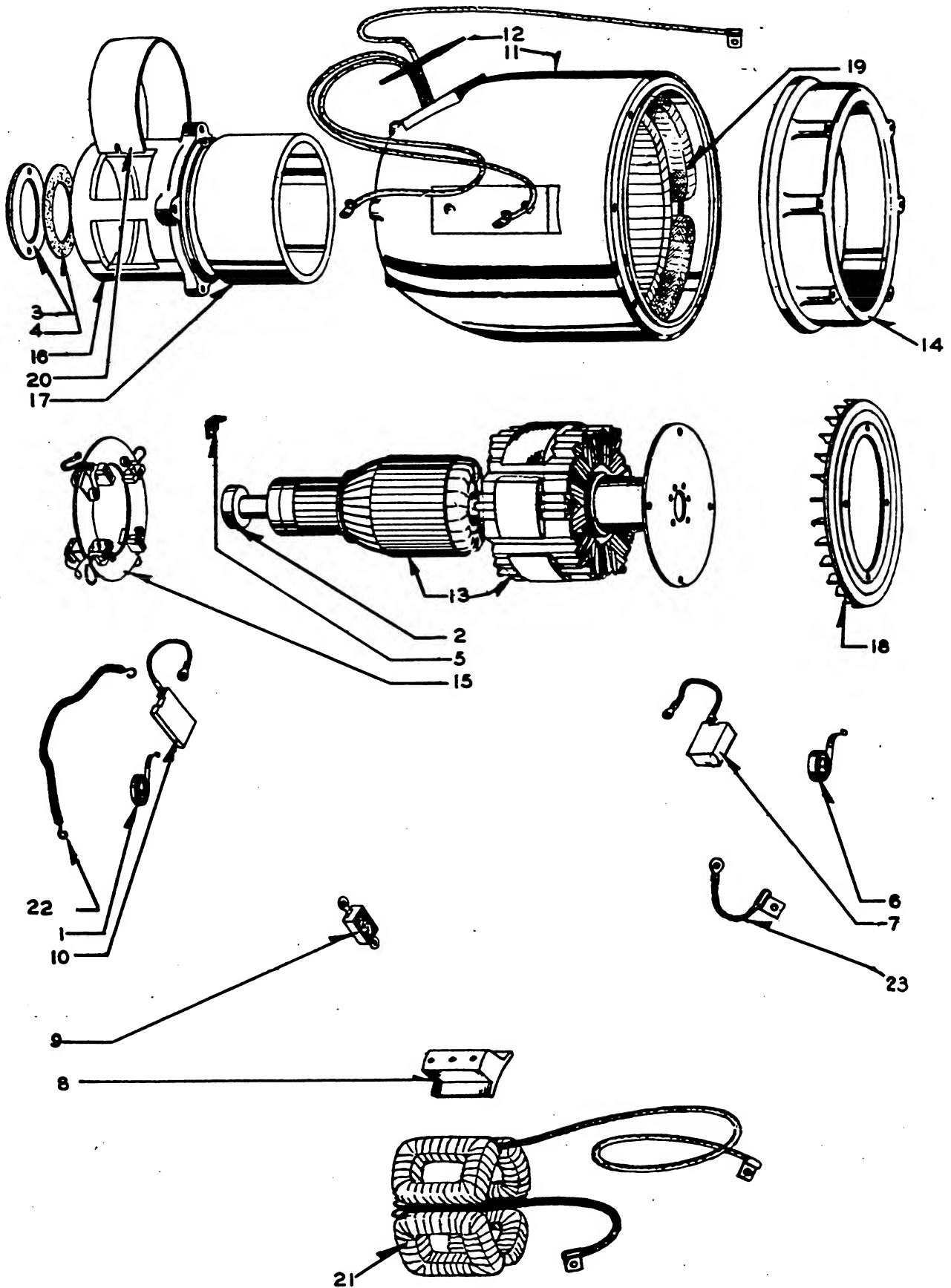


BATTERY CHARGING GENERATOR GROUP



STARTER GROUP





GENERATOR PARTS GROUP

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
CYLINDER GROUP				
1	2NC-6010	1	Block, Cylinder - Assembly Includes Sleeve and Bearing Caps.....	\$ 44.00
2	74120-S	1	Plug, Expansion - 1-3/16" - Rear of Cyl. Block...	.01
3	74129-S	1	Plug, Expansion - 2" - Rear Camshaft Hole.....	.01
4	9N-6017	1	Cover, Timing Gear Side.....	1.60
5	9N-6018	1	Gasket, Timing Gear Side Cover.....	.01
6	20388-S	8	Screw, Hex. Hd. Cap - 3/8" x 16" x 1" - Timing Gear Cover (3), Cylinder Front Cover (5)....	.02
7	34807-S	3	Washer, Lock - 3/8" - Cylinder Timing Gear Cover-Plate Bolt.....	.01
8	ONY-6019	1	Cover, Cylinder Front.....	23.25
9	9N-6020	1	Gasket, Cylinder Front Cover.....	.02
10	9N-6022	1	Gasket, Governor to Timing Gear Side Cover.....	.04
11	2NC-6050	1	Head, Cylinder.....	5.00
12	(9N-6051)	1	Gasket, Cylinder Head.....	.65
13	351025-S7	18	Nut, Hex. - 7/16"-20 - Cylinder Head Stud.....	.02
14	99A-6055	4	Sleeve - Cylinder Block.....	1.65
15	40-6057-C	4	Insert - Valve Seat - Intake.....	.25
16	52-6057-E	4	Insert - Valve Seat - Exhaust.....	.25
17	9N-6066	14	Stud, Cylinder Block - Short.....	.03
18	48-6067	4	Stud, Cylinder Block - Long.....	.04
19	18-6397	2	Dowel, Cylinder to Valve Chamber Cover.....	.04
	33798-S	3	Nut, Hex. - 5/16" -24 - Cylinder Block.....	.02
PISTON AND CONNECTING ROD GROUP				
20	9N-6100	4	Piston and Connecting Rod Assembly.....	4.50
21	99A-6110-A	4	Piston, Standard.....	1.65
22	99A-6135-A	4	Pin, Piston.....	.30
23	78-6140	8	Retainer, Piston Pin.....	.01
	9NS-6149		Ring, Piston - Complete Set in Carton.....	2.60
24	99A-6150-A	8	Ring, Piston - Compression.....	.10
25	99A-6153-A	4	Ring, Piston Oil Control.....	.15
26	9N-6200	4	Rod, Connecting Assembly.....	2.75
27	9N-6211-A	8	Liner, Connecting Rod Bearing.....	.25
28	18-6212	8	Nut, Connecting Rod Bolt.....	.05
29	352250-S	8	Pin, Cotter - Connecting Rod - Special.....	.01
30	351393-S	1	Washer, Connecting Rod Lock.....	.01
CAMSHAFT AND CRANKSHAFT GROUP				
31	2NC-6250	1	Camshaft.....	5.00
	91A-6258	1	Ring, Camshaft Gear Locking - Not Illustrated...	.05
	350400-S	1	Bolt, Camshaft Gear - Not Illustrated.....	.01
32	11A-6256	1	Gear, Camshaft.....	3.35
33	91A-6266	1	Seal, Camshaft Rear Bearing.....	.12
34	9N-6303	1	Crankshaft.....	18.50
35	74156-S	1	Key, Woodruff - 1/4" x 1/8" Crankshaft Gear.....	.04
36	48-6306	1	Gear, Crankshaft.....	1.10

*Above parts except those marked * are obtainable at Ford Service Stations.

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
CAMSHAFT AND CRANKSHAFT GROUP CONT'D.				
37	40-6310	1	Slinger, Crankshaft Oil.....\$.07
38	9N-6312	1	Pulley, Crankshaft - Assembly.....	1.55
39	B-6319-A	1	Ratchet, Crankshaft.....	.30
40	9N-6325	1	Cap, Crankshaft Bearing - Rear.....	.95
41	9N-6330	1	Cap, Crankshaft Bearing - Center.....	.95
42	9N-6331-A	2	Liner, Main Bearing - Center.....	.90
43	9N-6333-A	4	Liner, Main Bearing - Front and Rear.....	.40
44	91A-6335	1	Seal, Crankshaft Rear Bearing - Oil.....	.25
45	9N-6345	5	Stud, Main Bearing Cap - Short.....	.15
46	9N-6346	1	Stud, Main Bearing Cap - Long.....	.20
47	B-6348	6	Nut, Castle - 1/2"-20 - Special.....	.10
48	9N-6603	1	Cap, Bearing - Front - and Oil Pump Body.....	2.90
192A1-49	*75782)	1	Crank, Starting.....	1.50
FLYWHEEL GROUP				
50	9N-6375	1	Flywheel & Ring Gear Assembly.....	7.50
51	350645-S	4	Bolt, Hex. Hd. - 7/16"-20 x .88" - Flywheel to Crankshaft.....	.07
52	9N-6384	1	Gear, Flywheel Ring.....	1.40
53	B-6387	2	Dowel, Flywheel to Crankshaft.....	.04
VALVE GROUP				
54	18-6500-A	8	Rod, Push - Valve.....	.25
55	9N-6505	4	Valve - Exhaust.....	.50
56	11A-6505	4	Valve - Intake.....	.55
57	40-6510-A	8	Bushing, Valve Guide (2 pieces).....	.30
58	40-6512	8	Retainer, Valve Guide Bushing.....	.02
59	2NC-6513	8	Spring, Valve.....	.30
60	40-6514-B	8	Retainer, Valve Spring.....	.03
	9N-6520	1	Cover, Valve Chamber - Not Illustrated.....	.25
61	*78077	1	Cover, Valve Chamber with Breather Outlet.....	.75
62	9N-6521	2	Gasket, Valve Chamber Cover.....	.10
63	88146-S	2	Stud, Valve Chamber Cover - 5/16".....	.02
64	33798-S2	2	Nut, Hex. - 5/16"-24 - Valve Chamber Cover.....	.01
65	34806-S2	2	Washer, Lock - Valve Chamber Cover Stud - 5/16".....	.01
OIL PRESSURE RELIEF VALVE AND OIL PAN GROUP				
66	01A-6654	1	Spring, Oil Relief Valve.....	.01
67	01A-6663	1	Plunger, Oil Relief Valve.....	.01
68	68-6666	1	Nut, Oil Relief Valve.....	.06
69	2NC-6675	1	Pan, Oil.....	20.00
70	B-6700	2	Packing, Oil Pan and Cylinder Front Cover.....	.08
71	91A-6701	2	Packing - Crankshaft - Rear.....	.10
72	9N-6710	1	Gasket, Oil Pan - Right Hand.....	.12
73	9N-6711	1	Gasket, Oil Pan - Left Hand.....	.12

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REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
OIL PRESSURE RELIEF VALVE AND OIL PAN GROUP CONT'D.				
74	20346-S2	14	Screw, Hex. Hd. Cap - 5/16"-18 x 3/4" - Engine Pan to Block.....\$.01
75	34806-S2	16	Washer, Lock - 5/16" - Engine Pan to Block Bolt..	.01
76	*76734	1	Gasket, Drain Plug.....	.35
77	*75748BA	1	Cap, Oil Drain and Screen - Complete with Bushing 1/4" x 3/4".....	2.90
78	*75749	1	Elbow, Street - 1/2" P.T. - 90° - Oil Drain.....	.15
79	*75854	1	Nipple, Pipe - 1/2" P.T. - 11" Long - Oil Drain..	.35
80	*75858	1	Coupling, Pipe - 1/2" P.T. - Oil Drain.....	.15
501-9	*76552	1	Line, Oil - 35" x 1/4" - Oil Pressure Gauge to Oil Filter Tee - Not Illustrated.....	1.50
	*76553	1	Line, Oil - 33" x 1/4" - Magneto Gearcase to Engine Block - Not Illustrated.....	1.15
81	*10703	1	Plug, Pipe - 1/2" P.T. - Oil Drain.....	.15
82	2NC-6750	1	Indicator, Oil Level.....	.15
83	2NC-6754	1	Tube, Oil Level Indicator.....	.20
84	9N-6763	1	Pipe Assembly - Oil Filler.....	.45
85	52-6766	1	Cap Assembly - Oil Filler.....	.30
86	52-12410	1	Gasket, Pressure Relief.....	.01
	*78065	1	Bar, 3/4" x 3/4" x 1" - Brass - Oil Line Fitting.	.20
MANIFOLD GROUP				
87	2NC-9425	1	Manifold, Intake and Exhaust.....	5.50
88	88403-S	4	Stud, Exhaust Manifold - 7/16".....	.04
89	33816-S	4	Nut, Hex. - 7/16"-20 - Exhaust Manifold Stud.....	.03
	351436-S7	4	Washer, Lock - 7/16" - Manifold - Not Illustrated	.02
90	9N-9448	2	Gasket, Manifold.....	.05
153-80	*78021	2	Clamp, Exhaust Pipe.....	.35
	*75982	1	Pipe, Exhaust.....	.45
	*75983	1	Elbow, Exhaust.....	.60
	801-32-2	2	Screw, Hex. Hd. Cap - 5/16"-18 x 1-3/4" - Exhaust Pipe Clamps.....	.03
		5	Screw, Hex. Hd. Cap - 1/4"-20 x 1/2" - Exhaust Compartment Top Plate.....	.01
	871-26-3	3	Nut, Hex - 5/16"-18 - Brass - Exhaust Pipe Clamps	.02
		5	Nut, Hex. - 1/4"-20 - Exhaust Compartment Top Plate.....	.01
	850-45-2	2	Washer, Lock - 5/16" - Exhaust Pipe Clamps.....	.01
		5	Washer, Lock - 1/4" - Exhaust Compartment Top Plate.....	.01
WATER PUMP PARTS GROUP				
	9N-8501	1	Pump, Water Assembly.....	7.75
91	9N-8505	1	Housing, Water Pump.....	2.50
92	20318-S7	1	Bolt, Hex. Hd. - 5/16"-18 x 9/16" - Water Pump Housing to Cylinder Block.....	.02

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REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
WATER PUMP PARTS GROUP CONT'D.				
93	88371-S	3	Stud, 5/16" - Water Pump Body to Cyl.-Block.....\$.02
94	33798-S2	3	Nut, Hex. - 5/16"-24 - Water Pump Stud.....	.01
95	34806-S2	4	Washer, Lock - 5/16" - Water Pump Body to Cylinder Block.....	.01
96	9N-8507	1	Gasket, Water Pump.....	.03
97	9N-8508	1	Cover, Water Pump.....	.15
98	78-8512	1	Impeller, Water Pump.....	.40
99	9N-8513	1	Gasket, Water Pump - Rear.....	.02
100	68-8524	1	Seal, Water Pump.....	.10
101	79-8530	1	Bearing, Water Pump Assembly.....	2.50
102	68-8557-A	1	Washer, Water Pump.....	.20
103	68-8560	1	Spring, Water Pump.....	.04
104	68-8572	1	Ring, Clamp - Water Pump.....	.02
105	68-8573	1	Guide, Water Pump Spring.....	.04
106	68-8574	1	Wire, Water Pump Seal Snap.....	.01
107	9N-8576	1	Ring, Water Pump Body Snap.....	.05
	20318-S	1	Screw, Hex. Hd. Cap - 5/16"-18 x 9/16" - Water Pump Body Assembly.....	.02
FAN ASSEMBLY AND IDLER PULLEY GROUP				
108	9N-8606	1	Pulley, Fan.....	2.25
109	20325	4	Screw, Hex. Hd. Cap - 1/4"-28 x 5/8" - Fan Mtg...	.02
110	34805-S	1	Washer, Lock - 1/4" - Fan Mounting.....	.01
111	* 75755B	1	Pulley, Idler.....	.75
112	*75756	1	Stud, Idler Pulley.....	.25
113	*75690B	1	Bracket, Idler Pulley.....	1.10
114	*75759	1	Bearing, Idler Pulley - SKF #FL20.....	2.90
115	*75760	1	Ring, Idler Pulley Lock.....	.05
116	*75859	1	Fan, Assembly.....	3.50
117	*76554	1	Pin, Idler Stud Grove.....	.10
118	*75757-B	1	Arm, Idler Pulley.....	.85
119	3HC636	1	Screw, Adjusting - 3/8"-16 x 2-1/4" - Idler Pulley	.25
	9HC6	1	Nut, Hex. Hd. Cap - 3/8"-16.....	.02
120	*75860	1	Belt, Fan.....	1.00
121	*75757-S	1	Stud, Idler Pulley Pivot Arm and Nut.....	.25
122	*75737	1	Shroud, Fan.....	4.50
123	*74805	1	Guard, Fan.....	3.70
	3HC872	1	Screw, Hex. Hd. Cap - 1/2"-13 x 4-1/2" - Idler Pivot Bolt.....	.15
	6L8-1101	1	Washer, Lock - 1/2" - Idler Pivot Screw.....	.01
	9HC8	1	Nut, Hex. Hd. Cap - 1/2" - Idler Pivot Screw.....	.03
		2	Screw, Hex. Hd. Cap - 3/8"-16 x 1-1/8" - Idler Mounting Bracket.....	.03
		2	Washer, Lock - 3/8" - Idler Mounting Bracket.....	.01
		2	Washer, Plain - 3/8" - Idler Mounting Bracket....	.01

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REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
RADIATOR GROUP				
124	*74610	1	Radiator Assembly.....	30.50
125	22286-S2	2	Bolt, Hex. Hd. - 3/8"-24 x 2" - Radiator to Support.....	.06
126	34707-S2	2	Washer, Lock - 3/8" - Radiator to Support.....	.01
127	W145	1	Petcock, 1-1/4" - Radiator Drain.....	.40
128	9N-8260	1	Hose, Radiator Inlet - 1-1/2" x 7".....	.25
129	9N-8286	1	Hose, Radiator Outlet to Water Pump - 1-1/2" x 10-1/2".....	.55
130	60-8287	4	Clamp, Radiator Hose Assembly.....	.05
131	12217A	1	Cap, Radiator Assembly.....	1.20
132	*75856	1	Bushing, Pipe - 1/4" to 1/8" - Radiator Drain...	.10
133	75670	1	Thermostat Assembly - J1185.....	1.10
		2	Screw, R.H. Mach. - 1/4"-20 x 1/2" - Top Radiator Bracket to Front End Panel.....	.01
		2	Screw, R.H. Mach. - 10-32 x 3/8" - Radiator Guard.....	.01
		4	Nut, Hex. - 5/16"-18 - Radiator Support.....	.01
		2	Nut, Hex. - 1/4"-20 - Top Radiator Bracket to Front End Panel.....	.01
		4	Washer, Lock - 5/16" - Radiator Support.....	.01
		2	Washer, Lock - 1/4" - Top Radiator Bracket to Front End Panel.....	.01
GOVERNOR GROUP				
	*75470	1	Rod, Control - Modutrol Motor to Governor Lever.	1.20
134	*75862	1	Governor Assembly.....	24.00
	*75863	4	Joint, Ball - Throttle Control and Governor Control Rods.....	.50
	*78176	1	Lever, Governor.....	1.25
103A53	9N-6022	1	Gasket, Governor Mounting.....	.04
		1	Screw, Hex. Hd. Cap - 3/8"-16 x 1-1/4" - Governor Mounting.....	.03
		1	Screw, Hex. Hd. Cap - 3/8"-16 x 7/8" - Governor Mounting.....	.02
		2	Nut, Hex. - 5/16" - Governor Control Rod.....	.01
		2	Washer, Lock - 3/8" - Governor Mounting.....	.01
		2	Washer, Shakeproof #1214 - Governor Control Rod..	.01
SPARK PLUG AND IGNITION WIRING GROUP				
135	*78695	4	Plug, Spark.....	.65
136	*19853A	4	Shield, Spark Plug Assembly.....	.75
137	*78108	4	Adapter, Spark Plug.....	.70
138	52-12110	4	Gasket, Spark Plug.....	.01
139	*78338B	1	Wire, Spark Plug - #3 - Shielded.....	.45
140	*78339B	1	Wire, Spark Plug - #2 - Shielded.....	.45
141	*78340B	1	Wire, Spark Plug - #4 - Shielded.....	.45
142	*78341B	1	Wire, Spark Plug - #1 - Shielded.....	.45
143	*78337	1	Wires, Set of Spark Plug - 4 Wires - No Conduit..	1.75
144	9N-12112	1	Conduit, Ignition Wire.....	1.25

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REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
OIL PUMP GROUP				
1	9N-6603	1	Body, Oil Pump Assembly.....\$	2.90
2	9N-6608	1	Shaft and Gear, Drive Gear.....	2.10
3	52-6610-B	1	Gear, Driven.....	.55
4	9N-6612	1	Bushing, Oil Pump Body.....	.08
5	52-6614-B	1	Gear, Driving.....	.55
6	9N-6615	1	Cover, Screen Assembly.....	2.50
7	22503-S	3	Screw, Hex. Hd. Cap - 1/4"-20 x 5/8" - Oil Pump Cover.....	.04
8	9N-6619	1	Gasket, Oil Pump Cover.....	.01
OIL FILTER GROUP (Not Illustrated)				
			<i>122-37 Oil filter Cartridge</i>	
*78391		1	Filter, Oil.....	3.50
*122A14		1	Line, Oil - Assembly - Filter to Magneto Drive..	.60
*122A13		1	Line, Oil - Assembly - Filter to Crankcase.....	.65
*122A12		1	Line, Oil - Assembly - Filter to Block Drain....	.35
		1	Elbow, Inverted - 434X4 - Rear of Engine Block..	.33
		2	Elbow, Restricted Inverted - 431X4 - Magneto Drive (1), Crankcase End of Filter Line (1)	.19
		1	Elbow, Inverted - 400X4 - Bottom of Filter.....	.16
		1	Tee, Inverted - 600X4 - Side of Filter.....	.37
		1	Tee, Special Pipe - 3600X2 - Side of Filter.....	.36
		1	Plug, Pipe - 1/8" (In Filter Tee - Remove for Oil Gauge Line).....	.11
		2	Screw, Hex. Hd. Cap - 3/8"-16 x 3/4" - Oil Filter Mounting.....	.02
		2	Washer, Lock - 3/8" - Oil Filter Mounting.....	.01
		2	Washer, Plain - 3/8" - Oil Filter Mounting.....	.01
CARBURETOR AND FILTER GROUP				
1	*1098	1	Bowl, Filter.....	.30
2	*1099	1	Gasket, Filter Bowl.....	.10
3	*1097	1	Filter Assembly - Tillotson.....	1.25
4	9N-9447	2	Gasket, Carburetor to Manifold - Vellumoid.....	.02
5	*24202	1	Body, Throttle Assembly.....	4.85
6	S24160	4	Screw, 12-24 x 5/8" - Throttle Body to Body....	.05
7	*24193	4	Washer, Lock - Throttle Body to Body.....	.05
8	*24150	1	Body Assembly.....	4.45
9	20346-S2	2	Bolt, Hex. Hd. - 5/16"-18 x 3/4" - Man. to Carb.	.01
10	34806-S8	1	Washer, Lock - 5/16" - Manifold to Carburetor...	.01
11	*24162	1	Gasket, Carburetor Body.....	.05
12	*24187	1	Nozzle, Main.....	.50
13	*24189	1	Jet, Maximum Fuel Limiting.....	.20
14	*24171	1	Ratchet, Main Adjustment Assembly.....	.15
15	*24195	4	Washer, Lock - Choke (2), Throttle Fly (2).....	.05
16	*24195	4	Screw, #4-36 x 1/4" - Throttle Fly (2), Choke Fly (2).....	.05

*Above parts except those marked * are obtainable at Ford Service Stations.

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
CARBURETOR AND FILTER GROUP CONT'D.				
17	*24166	1	Spring, Choke Return.....	\$.15
18	*24170	1	Spring, Main Adjusting Needle.....	.10
19	*24183	1	Needle, Idling Adjustment.....	.25
20	*24174	1	Fly, Choke.....	.20
21	*24172	1	Lever Shaft Assembly - Choke.....	.75
22	*24180	1	Float Assembly.....	1.00
23	*10697	1	Elbow, Weatherhead #400X4.....	.16
24	*24181	1	Shaft, Float.....	.05
25	*24169	1	Spring, Choke Fly.....	.15
26	*24164	1	Gasket, Adjusting Needle Seat Plug.....	.05
27	*24203	1	Valve and Seat Assembly.....	.95
28	*24184	1	Needle Assembly.....	.45
29	*24194	1	Washer, Flat - 3/8" - #22 - Main Adj. Needle....	.05
30	*24168	1	Spring, Idle Adjusting Needle.....	.15
31	*24152	1	Fly, Throttle.....	.20
32	*24186	1	Venturi.....	.35
33	*24154	2	Screw, Main Adjustment Ratchet.....	.05
34	*24190	1	Jet, Idle.....	.20
35	*24161	1	Gasket, Check Valve Screw.....	.05
36	*24188	1	Jet, Economizer.....	.20
37	*24157	1	Screw, Headless - 1/4"-20 - Idle Drilling Plug..	.05
38	*75736	1	Rod, Carburetor to Governor Control.....	.30
	*75469	1	Link, Choke.....	.05
	*78284	1	Elbow, Street (3400X4).....	.16
39	*75736A	1	Rod, Carburetor to Governor Control Assembly....	1.30
40	*75747A	1	Shaft, Throttle Assembly.....	.75
41	*568	2	Joint, Carburetor and Governor Rod Ball.....	.20
42	*78109	1	Adapter, Carburetor Flange.....	.25
	*76690	1	Carburetor Assembly.....	11.85

FUEL PUMP GROUP

1	11A-9351	1	Body, Fuel Pump - Upper.....	.95
2	11A-9352	2	Valve, Fuel Pump.....	.12
3	20009-S2	1	Screw, Cover to Upper Half of Pump.....	.01
4	11A-9355	1	Cover, Fuel Pump.....	.10
5	40-9357	1	Washer, Cover Screw.....	.01
6	11A-9361	1	Plate, Valve Retaining - Fuel Pump.....	.02
7	68-9364	1	Gasket - Fuel Pump Cover.....	.02
8	11A-9365	1	Screen, Fuel Pump.....	.20
	11A-9367	2	Gasket, Fuel Pump Valve to Body (not illustrated)	.01
149-67	INC-9350	1	Fuel Pump Assembly (not illustrated).....	5.00
9	68-9375A	1	Body, Fuel Pump - Lower.....	.40
10	INC-9399	1	Arm, Rocker.....	.50
11	40-9378	1	Pin, Rocker Arm.....	.10
12	40-9380	1	Spring, Rocker Arm.....	.03
13	INC-9381	1	Link, Fuel Pump Drive.....	.08
14	40-9396	1	Spring, Diaphragm.....	.05

*Above parts except those marked * are obtainable at Ford Service Stations.

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
FUEL PUMP GROUP CONT'D.				
15	68-9398	1	Diaphragm Assembly.....	\$.40
16	IGA-9411	1	Washer, Oil Seal.....	.02
	40-9417	1	Gasket, Fuel Pump Body (not illustrated).....	.01
17	IGA-9468	1	Retainer, Fuel Pump Oil Seal.....	.02
18	IGA-9469	1	Seal, Oil - Fuel Pump.....	.02
19	B9182	1	Spring, Drain Cock - Fuel Pump.....	.01
20	B9185B	1	Cock, Drain - Fuel Pump.....	.07
21	31628-S7	6	Screw, Fuel Pump Body.....	.01
22	34803-S7	6	Washer, Lock - Body Screw.....	.01
	9N-18376	1	Gaskets, Kit of - Fuel Pump (not illustrated)....	.20
		2	Screw, Hex Hd. Mach. - 5/16"-18 x 7/8" - Fuel Pump Mounting.....	.01
		2	Washer, Lock - 5/16" - Fuel Pump Mounting.....	.01
MAGNETO AND GEARCASE GROUP				
1	9N-12143	1	Gasket, Magneto Gearcase.....	.02
2	*75750	1	Gearcase.....	6.50
3	*75751	1	Gearcase Cover.....	1.25
4	*75752	1	Gasket, Magneto Gearcase Cover.....	.10
5	*75753	1	Shaft, Drive.....	1.75
6	*75754	2	Gear, Magneto Drive and Driven.....	1.60
7	*75857	1	Magneto Assembly.....	25.00
8	*78707	1	Relay, Stop - Autolite - HRK-4001.....	2.00
9	*5944	1	Nut, Magneto Shield Outlet Nipple.....	.25
10	*5946	1	Shield, Magneto.....	1.50
11	*12119	1	Stud, Adjusting Assembly - Includes Nut and Drive Thrust.....	.20
12	*76811	1	Condenser, Magneto - Dubilier Type 3L .01 MFD....	.55
AIR CLEANER GROUP				
1	9N-9652	1	Hose, Air Cleaner Tube to Carburetor.....	.10
2	9N-9653	2	Clamp, Hose.....	.04
3	ONA-18205	1	Cleaner, Air Assembly.....	3.00
4	*78078	1	Tube, Air Cleaner Adapter.....	2.75
5	*75851	1	Bracket, Air Cleaner.....	1.25
6	*75865	1	Strap, Iron.....	.35
7	*78117	1	Tube, Breather - Valve Cover to Adapter - 1/2" I.D. x 6" - Flexible.....	.25
	*78079	2	Adapter, Breather Tube (not illustrated).....	.15
		2	Screw, Hex. Hd. Cap - 1/4"-20 x 5/8" - Air Cleaner Tube Clamp.....	.01
		2	Nut, Hex. Jam - #10-32 x 3/8" - Breather Tube Clamp.....	.01
		2	Nut, Hex. - 1/4"-20 - Air Cleaner Tube Clamp.....	.01
		2	Washer, Lock - 1/4" - Air Cleaner Tube Clamp.....	.01

*Above parts except those marked * are obtainable at Ford Service Stations.

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
MAGNETO PARTS GROUP				
1	X3788	1	Cap, Distributor Assembly - Includes Gasket, Screws, & Lock Washers.....\$	2.00
162-130 2	3734 499~	1	Gasket, Distributor Cap.....	.05
162-108 3	X3797	1	Arm, Distributor Assembly.....	.45
4	3795	1	Washer, Breaker Cover Sealing - Felt.....	.05
5	3796	1	Cover, Breaker.....	.25
6	1902	5	Screw, Fill. Hd. - #8-32 x 7/16" - Breaker Assy. (2), Cam (1), Secondary Terminal (2).....	.05
7	M-55XA	5	Washer, Lock - #8 - Cam Lock Screw (1), Breaker Arm Clamp Screw (1), Fixed Contact Screw (1), Breaker Assembly Screw (2).....	.05
8	3806	1	Plate, Cam Screw Lock.....	.05
9	3902	1	Cam, Breaker.....	1.00
10	16-738	2	Screw, Fill. Hd. - #8-32 x 5/16" - Breaker Arm Spring (1), Breaker Arm Clamp (1).....	.05
11	1207	1	Washer, Breaker Arm Clamp Screw.....	.05
162-136 12	12967-	1	Point, Magneto Breaker Set - Incl. #1408 & 1196.	1.75
13	1418	1	Spacer, Breaker Arm.....	.05
14	1197	1	Washer, Breaker Arm Spacer.....	.05
15	1196	1	Contact, Fixed.....	.50
16	X3976	1	Plate, Breaker.....	1.00
17	3573	1	Washer, Lock - Int. Shakeproof - Breaker Arm Spring Screw.....	.05
18	1383	2	Screw, Fill. Hd. - #6-32 x 3/4" - Condenser Mtg.	.05
19	M-90X	2	Washer, Lock - #6- Condenser Screw.....	.05
162- 20	12969	1	Condenser Assembly - Includes X1413.....	1.20
21	M-31X	1	Screw, Oval Hd. - #8-32 x 5/16" - Fixed Contact Mounting.....	.05
22	IXA-256	1	Washer, Fixed Contact Screw.....	.05
23	M-36X	2	Washer, 3/8" - Breaker Assembly Clamp.....	.05
24	M54X	3	Washer, Lock - #8 - Secondary Terminal Screw....	.05
25	1533	1	Gasket, Condenser Case.....	.05
26	X3975	1	Housing, Main.....	6.75
28	4474	2	Shield, Coil - Fabric.....	.10
29	3682	1	Coil.....	3.00
30	4299	2	Washer, Inner Core Spacing - Felt.....	.05
31	X3765	1	Core, Inner (Group).....	.50
32	3783	1	Ring, Inner Core Snap.....	.05
162-116 33	X3910	1	Rotor.....	6.75
34	3802	1	Gasket, Bearing Plate Housing.....	.05
36	X3826	1	Plate, Bearing - Includes Bearing.....	1.75
37	M-116X	2	Washer, Plain - 1/4" - Bearing Plate Clamp Screw	.05
38	1130	4	Screw, Fill. Hd. 1/4"-20 - Main Housing to Bear- ing Plate (2), Bearing Plate to End Plate (2).....	.05
39	X3960	1	Plate, Support.....	.75
40	X4600	2	Spring, Impulse Group - Includes Impulse Spring Guide.....	.70

*Above parts except those marked * are obtainable at Ford Service Stations.

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
MAGNETO PARTS GROUP CONT'D.				
41	X3958	1	Plate, Cam.....	\$.50
42	3977	1	Shaft, Drive.....	1.50
43	X3979	1	Plate, End - Includes Impulse Stop Pins.....	2.50
44	1127	2	Washer, End Plate Screw Clamp.....	.05
45	M-95X	4	Pin, Cotter - 3/64" x 3/8" - Trip Arm Pivot.....	.05
46	3771	2	Pivot, Trip Arm.....	.15
47	4779	2	Spring, Trip Arm.....	.10
48	4113	2	Washer, Lock - Shakeproof #1120 - Cam Plate Group (1), Support Plate Clamp (1).....	.05
49	4768	2	Arm, Trip.....	.75
50	4112	2	Nut, Hex - 3/8"-24 x 5/16" - Cam Plate Assembly Group (1), Support Plate Clamp (1).....	.05
51	Y3684	1	Pencil, Secondary.....	.50
52	IXA-345	2	Plug, Oil.....	.05

MISCELLANEOUS OIL, FUEL, AND WATER LINES AND FITTINGS
(Not Illustrated)

(*648) 501A	1	Line, Fuel - Flex. - 24".....	1.25
(*78739	1	Line, Oil - Pressure - 3' x 1/4".....	1.10
*200X4	2	Connector, Inverted - Male - 1/8" x 1/4".....	.12
*10697	4	Elbow, Inverted Male - 1/8" x 1/4" (400X4).....	.16
*W145	1	Petcock - 1/4" - Drain for Block.....	.40
*76732	1	Hose, Oil Gauge - Flexible - 10902 x 36.....	1.25
*105X4	6	Nut, Inverted.....	.09
*250X4	2	Connector, Inverted Female.....	.19

BATTERY CHARGING GENERATOR GROUP

	*75971	1	Generator - (not illustrated).....	25.00
1	01A10005	1	Armature.....	4.55
	68-10044	2	Screw, Generator Pole Piece (not illustrated)...	.01
2	01A-10050	1	Plate, End and Brush Assembly.....	1.55
3	91A-10057	2	Spring, Brush.....	.03
4	01A-10069	2	Brush.....	.20
5	B-10094	1	Bearing.....	1.15
	19B-10096	1	Ring, Generator Pulley Retaining (not illustrated)	.01
6	01A-10098	1	Retainer, Grease.....	.01
7	78-10120	2	Bolt, Generator Frame Through.....	.02
8	01A-10121	1	Retainer, Grease.....	.01
9	01A-10122	1	Seal, Grease - Front End.....	.02
10	01A-10130-A	1	Pulley.....	1.50
11	1NC-10139	1	Plate, End.....	1.65
12	B-10141	1	Cup, Oil - Commutator End.....	.04
	18-10142-A	2	Band, Generator and Starter Cover (not illus.)..	.05

*Above parts except those marked * are obtainable at Ford Service Stations.

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
BATTERY CHARGING GENERATOR GROUP CONT'D.				
13	18-10146	1	Plug, Brush End Plate Oil.....\$.01
	99B-10151	1	Support, Generator (not illustrated).....	8.75
	SE51-10152	2	Washer, Generator Support (not illustrated).....	.20
14	01A-10163	1	Ring, Bearing Stop.....	.01
15	*75977	1	Coil, Field - Set.....	6.00
16	81A-10206	1	Insulator, End Plate - Outer.....	.06
17	81A-10208	1	Insulator, End Plate - Inner.....	.01
18	01A-10212	1	Seal, Grease - Rear.....	.01
19	81A-10211	1	Screw, Terminal.....	.01
20	78-10214-B	1	Retainer, Oil.....	.01
21	81A-10221	1	Insulator, Brush Terminal.....	.01
22	01A-10202	1	Insulator, Terminal.....	.06
	*74600	1	Shaft, Drive (not illustrated).....	2.80
	*74602	1	Guard, Belt (not illustrated).....	5.50
	*74603	1	Bracket, Generator Mounting (not illustrated)...	6.50
	*74604	1	Pulley, Drive (not illustrated).....	2.50
	*74605	1	Bracket, Belt Guard (not illustrated).....	
	*75860	1	Belt, Generator Drive (not illustrated).....	1.15
	*76811	1	Condenser, .01 MFD (not illustrated).....	.55
		2	Screw, Hex. Hd. Cap - 5/16"-18 x 3/4" - Generator Bracket to End Bearing Cover....	.01
		1	Screw, Hex. Hd. Cap - 5/16"-18 x 1/2" - Belt Guard Bracket to Generator Bracket.....	.01
		2	Screw, Hex. Hd. Cap - 3/8"-16 x 4" - Generator Mounting Bracket.....	.08
		1	Screw, Hex. Hd. Cap - 3/8"-16 x 2-1/2" - Belt Adjustment.....	.05
		4	Screw, R.H. Mach. - 1/4"-20 x 1/2" - Belt Guard Mounting.....	.01
		1	Nut, Hex. - 3/8"-16 - Belt Adjustment.....	.02
		2	Washer, Lock - 3/8" - Generator Mounting Brkt...	.01
		3	Washer, Lock - 5/16" - Belt Guard Bracket to Generator Bracket (1), Generator Bracket to End Bearing Cover (2).....	.01
		4	Washer, Lock - 1/4" - Belt Guard Mounting.....	.01
		4	Washer, Plain - 1/4" - Belt Guard Mounting.....	.01
STARTER GROUP				
	*75971	1	Starter - Less Drive (not illustrated).....	25.00
1	52-11005	1	Armature.....	3.65
2	18-11036	1	Washer, Armature Thrust.....	.01
3	18-11049	1	Plate - Brush End - Assembly.....	.75
4	18-10088	1	Dowel.....	.01
5	18-11057	1	Brush - Complete Set.....	.60
6	B-11059	4	Spring, Brush.....	.03
7	18-11061	4	Holder, Brush.....	.01
8	18-10142A	1	Band, Cover.....	.05
9	18-11083	1	Coil, Field - Left.....	.65

*Above parts except those marked * are obtainable at Ford Service Stations.

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
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STARTER GROUP CONT'D.

10	18-11085	1	Coil, Field - Right.....	\$.65
11	18-11091	2	Bolt, Thru.....	.03
12	18-11102	1	Field, Contact.....	.05
13	52-11130	1	Plate - Rear End - Assembly.....	.85
14	52-11367	1	Pinion and Barrel.....	1.90
15	52-11365B	1	Pin, Pinion.....	.02
16	52-11375	1	Spring, Starter Drive.....	.60
17	52-11368	1	Meshing, Spring.....	.20
18	52-11369	1	Anti-Drive, Spring.....	.12
19	52-11370	1	Ring, Pinion Retainer.....	.03
20	52-11372	1	Spring, Anchor Plate.....	.25
21	*78380	1	Switch, Solenoid Start - 12 Volt.....	2.75
22	18-11094	3	Washer, Field Terminal.....	.01
23	B-11062	4	Insulator, Brush Holder.....	.01
24	52-11373	1	Ring, Spring Lock.....	.05
25	52-11366-B	1	Shaft, Drive Screw.....	2.55

GENERATOR PARTS GROUP

242A1004	1	(*19653)	4	Spring, Brush Collector Ring.....	.25
510A2	2	(5055)	1	Bearing, Generator - #7603.....	5.35
	3	*74601	1	Cover, Exciter End Bell.....	2.15
	4	*5156	1	Gasket, Exciter End Bell Cover.....	.20
	5	*5160	1	Clip, Bearing Stop.....	.15
	6	*5190	4	Spring, D.C. Brush.....	.35
	7	*5195	4	Brush, D.C.....	1.00
	8	*12508	4	Shoe, Pole - Assembly.....	3.50
	9	*76811	2	Condenser, Filter.....	.55
	10	*5196	4	Brush, Collector Ring.....	.75
	11	*75526C	1	Frame, Generator Only.....	95.00
	12	*75538	1	Cover, Generator Outlet.....	1.25
	13	*78346	1	Rotor Assembly.....	150.00
	14	*75876	1	Adapter, Generator.....	28.50
	15	*75579B	1	Rig, Brush - Assembly.....	15.50
	16	*75580	1	Bell, Exciter End.....	10.25
	17	*75482	1	Frame, Exciter - Manual.....	8.50
	18	*75877	1	Blower, Generator.....	18.50
	19	*78347	1	Stator and Winding - Laminated.....	150.00
	20	*75592	1	Band, Exciter End Bell.....	.95
	21	*75563	1	Coil, Exciter Field Assembly.....	30.00
	22	*75785	1	Jumper, Collector Ring Brush - #8 Wire.....	.35
	23	*75787	2	Jumper, Ground - Flexible.....	.35
		*12508	4	Shoe, Pole - Assembly.....	3.50
		*17708	1	Box, Outlet.....	8.35
		*75883	6	Stud, 3/8" x 7-1/2" - Generator Frame to Adapter	.25
			1	Screw, Hex. Hd. Cap - 5/16"-18 x 1-1/4" - Bearing Cap Mounting.....	.02

*Above parts except those marked * are obtainable at Ford Service Stations.

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
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GENERATOR PARTS GROUP CONT'D.

1	Screw, Hex. Hd. Cap - 5/16"-18 x 3/4" - Bearing Cap Mounting.....\$.01
4	Screw, Hex. Hd. Cap - 5/16" x 3/4" - Brush Rig to End Bell.....	.01
1	Screw, Hex. Hd. Cap - 1/2"-13 x 1/2" - Plugs Eyebolt Hole in Frame.....	.01
6	Nut, Hex - 3/8"-24 - Generator Frame to Adapter.	.02
6	Washer, Lock - 5/16" - Bearing Cap Mounting (2) Brush Rig to End Bell (4).....	.01
6	Washer, Lock - 3/8" - Generator Frame to Adapter.....	.01
2	Washer, Flat - 3/4" - Brass - Brush Rig to End Bell.....	.02
2	Washer, Flat - 5/16" - Brush Rig to End Bell....	.01

CONTROL GROUP
(Not Illustrated)

78325	1	Rheostat - Model K - 300 Ohm.....	25.00
78707	1	Relay, Stop 1 & RK-4001.....	2.00
75466	1	Bracket, Modutrol Motor.....	1.50
75472	1	Bracket, Conduit.....	1.50
78017	1	Bracket, Terminal Board.....	.15
78354	1	Box, Regulator.....	2.65
78355	1	Panel, Regulator Box.....	1.00
78357	2	Bracket, Voltage Regulator - Vibration Dampener.	.55
78358	2	Bracket, Voltage Regulator - End.....	.45
79605	1	Box, Terminal.....	4.50
1422	1	Switch, Toggle.....	.75
15168	1	Gauge, Oil.....	1.50
193-2 - 76567	1	Gauge, Water Temperature.....	3.00
75976	1	Motor, Modutrol Assembly.....	60.00
75972	1	Regulator, Voltage - VRX4002 - Autolite.....	6.00
75973	1	Regulator, A.C. Voltage.....	119.00
75986	1	Control, Automatic Choke.....	5.00
75635	1	Switch, Solenoid Starting.....	2.75
1740	1	Switch, Start-Stop.....	1.00
79521		Ammeter.....	2.50
75975	1	Transformer, Potential.....	14.00
1987	4	Conduit, Flexible - 1/2" x 7'.....	1.25
10781	5	Connector, Greenfield - Straight.....	.25
	2	Connector, Greenfield - 90°.....	.25
75873	1	Panel, Current Transformer.....	1.00
74802	1	Bracket, Stop Relay Mounting.....	.35
74263	1	Switch, High Temperature Cut-Off.....	9.50
331-1	2	Connector, Greenfield - 3/8" Angle.....	.20
75974	4	Base, Vibration Dampener - Voltage Regulator....	60.00
78070	1	Plate, Base - Voltage Regulator.....	10.50
78487	1	Panel, Terminal.....	1.25
1805	3	Coil, Choke - RF 581.....	.75
75356	3	Support, Choke Coil.....	.12

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
CONTROL GROUP CONT'D.				
1413		3	Stud, 1/4"-20 x 1-3/4" - Brass - Terminal Stud..\$.10
		1	Screw, Hex. Hd. Mach. 5/16"-18 x 1-1/4" - Brass- Ground Terminal on Housing.....	.02
		2	Screw, Hex. Hd. Cap - 5/16"-18 x 5/8" - Outlet Box Mounting.....	.02
		2	Screw, Rd. Hd. Mach. - 1/4"-20 x 3/8" - Brass - Choke Control Mounting.....	.02
		5	Screw, Rd. Hd. Cap - #10-32 x 1/2" - Stop Wire Clamp Mounting (1), Stop Relay Mounting(4)	.01
		4	Screw, Rd. Hd. Mach. - #10-32 x 3/4" - Brass - Outlet Box Panel Mounting.....	.02
		7	Screw, Rd. Hd. Mach. - #10-32 x 1/2" - Start Solenoid Mounting (2), Outlet Box Cover (1), Voltage Regulator Mounting (4).....	.01
		5	Screw, Rd. Hd. Mach. #10-32 x 3/8" - Voltage Regulator Mounting (4), Voltage Regulator (1).....	.01
		1	Screw, Rd. Hd. Mach. -#8-32 x 3/8" - Choke Clamp	.01
		10	Stud - #10-32 x 1-1/2" - Brass - Terminal Stud..	.03
		12	Nut, Hex. - 1/4"-20 - Terminal Stud.....	.01
		44	Nut, Hex. - #10-32 - Stop Relay Mounting (4), Terminal Stud (40).....	.01
		11	Washer, Lock - #10 - Stop Relay Mounting (4), Stop Wire Clamp Mounting (1), Voltage Regulator Mounting (4), Start Solenoid Mounting (2),.....	.01
		2	Washer, Lock - 5/16" - Outlet Box Mounting.....	.01
		2	Washer, Shakeproof - 1/4" - Internal Tooth - Choke Control Mounting.....	.01
		45	Washer, Shakeproof - #1110 - Panel Mounting (4), Terminal Stud (40), Box Cover (1).....	.01
		24	Washer, Plain - #10 - Brass - Terminal Stud.....	.02
		5	Washer, Plain - #10 - Voltage Regulator Mounting (4), Voltage Regulator to Adapter (1), Outlet Box Cover (1).....	.01
		2	Washer, Plain - 5/16" - Outlet Box Mounting.....	.01
		2	Washer, Plain - 1/4" - Brass - Terminal Stud....	.02
HOUSING PARTS GROUP (Not Illustrated)				
75882		1	Panel, Rear End.....	15.00
78559		1	Bracket, Crank Support.....	1.00
74800		1	Panel, Front End.....	10.00
78578		1	Support, Front Engine.....	8.50
78128B		1	Plate, Side - Right Hand.....	10.50
78129B		1	Plate, Side - Left Hand.....	10.50

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
HOUSING PARTS GROUP CONT'D. (Not Illustrated)				
74804		1	Grille, Radiator.....	\$ 2.65
75766		1	Plate, Top - Exhaust.....	4.50
74806		1	Support, Radiator.....	1.30
78286		1	Mounting, Front Engine.....	5.50
74609		1	Housing, Radiator.....	8.50
78288		2	Spring, Engine Mounting.....	1.50
15162		1	Spring, Crank Clamp.....	.15
73287		2	Block, Generator Shim.....	1.50
74607		2	Bracket, Radiator to Panel.....	.55
76727		1	Clamp, Crank65
78074		1	Plate, Crank Support.....	2.25
		2	Screw, Hex. Hd. Cap - 7/16"-14 x 1-1/2" - Upper Front Engine Mounting.....	.04
		8	Screw, Hex. Hd. Cap - 7/16" 014 x 1" - Front Engine Mounting Bracket to Housing Side Plate (6), Front Engine Mounting (2).....	.02
		4	Screw, Hex. Hd. Cap - 5/16"-18 x 7/8" - Radiator Support.....	.02
		8	Screw, Hex. Hd. Cap - 5/16"-18 x 3/4" - Modutrol Bracket to Housing Side Plate (2), Radiator Grill Mounting (6).....	.01
		2	Screw, Hex. Hd. Cap - 3/4"-10 x 2-1/2" - Gener- ator to Side Panel.....	.06
		10	Screw, Hex. Hd. Cap - 3/8"-16 x 3/4" - Front End Panel Mounting (4), Rear End Panel Mtg.(6).....	.02
		4	Screw, Hex. Hd. Cap - 1/4"-20 x 7/8" - Modutrol Mounting to Bracket.....	.01
		3	Screw, Hex. Hd. Cap - 1/4"-20 x 5/8" - Front Dust Pan to Motor Support.....	.01
		2	Screw, Hex. Hd. Cap - 1/4"-20 x 3/4" - Fan Guard to Crank Support.....	.01
		2	Screw, Hex. Hd. Cap - 1/4"-20 x 1/2" - Front Dust Pan to Motor Support.....	.01
		4	Screw, Rd. Hd. Mach. - #10-32 x 3/4" - Fan Guard to Radiator.....	.01
		11	Screw, Speed - #14 x 3/4" - Front End Panel.....	.02
		10	Nut, Hex. - 7/16"-14 - Front Engine Mounting (2), Upper Front Engine Mounting (2), Front Engine Mounting Bracket to Housing Side Plate (6).....	.02
		6	Nut, Hex. - 5/16"-18 - Radiator Grill Mounting..	.02
		10	Nuts, Hex. Head - 3/8"-16 - Rear End Panel Mounting (6), Front End Panel Mounting (4).....	.02
		1	Nut, Thumb - 1/4"-20 - Crank Clamp.....	.05
		11	Nut, Body Speed - #1383 - Thick - Front End Panel.....	.02

REF. NO.	PART NO.	QUAN. USED	DESCRIPTION	PRICE EACH
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HOUSING PARTS GROUP CONT'D.

5	Nut, Hex. - 1/4"-20 - Front Dust Pan to Motor Support.....	\$.01
10	Washer, Lock - 7/16" - Front Engine Mounting Bracket to Housing Side Plate (6), Front Engine Mounting (2), Upper Front Engine Mounting (2).....		.01
2	Washer, Lock - 3/4" - Generator to Side Panel...		.01
8	Washer, Lock - 5/16" - Modutrol Bracket to Housing Side Plate (2), Radiator Grill Mounting (6).....		.01
10	Washer, Lock - 3/8" - Front End Panel Mounting (4), Rear End Panel Mounting (6).....		.01
10	Washer, Lock - 1/4" - Front Dust Pan to Motor Support (5), Modutrol Mounting to Bracket (4), Crank Clamp (1), Fan Guard to Crank Support (2).....		.01
2	Washer, Lock - #10 - Fan Guard to Radiator.....		.01
2	Washer, Plain - 7/16" - Upper Front Engine Mtg..		.01
4	Washer, Plain - 1/4" - Fan Guard to Crank Support		.01
4	Washer, Plain - #10 - Fan Guard to Radiator.....		.01

MISCELLANEOUS PARTS GROUP

76811	6	Condenser, Filter.....	.55
78524	1	Clamp, Condenser Terminal.....	.10
75727	1	Clamp, One Hole.....	.60
1746D	1	Cable, Starter to Solenoid Start Switch - 6"....	.50
1746B	1	Cable, Solenoid Starting Switch to Terminal Post on Housing - 36".....	.90
75471B	2	Dampener, Vibration - Plant Mounting - Front....	2.30
75471C	2	Dampener, Vibration - Plant Mounting - Center...	2.30
75471D	2	Dampener, Vibration - Plant Mounting - Rear.....	2.30

